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THE INSTITUTE DINNER IN HONOUR OF ROBERT PRICE RUSSELL

ON June 5, 1947, Mr Robert Price Russell, Cadman Memorial Lecturer and Medallist, 1947, was the guest of honour at a dinner held by the Institute of Petroleum at the Dorchester Hotel, London.

In the unavoidable absence of the President of the Institute, the Chair was taken by Sir William Fraser, C.B.E., and he was supported by H. C. Tett (*Chairman of Council*); Lt-Col S. J. M. Auld, O.B.E., M.C., T. Dewhurst, Prof F. H. Garner, O.B.E. (*Past-Presidents*); and G. H. Coxon, E. A. Evans, A. C. Hartley, C.B.E., and J. A. Oriel, C.B.E., M.C. (*Vice-Presidents*).

Among those at the top table were: Lord Cadman, Sir Donald Fergusson, K.C.B. (*Ministry of Fuel and Power*); Prof Alan Nevins (*representing the American Ambassador*); Sir Robert Robinson (*The Royal Society*); D. A. Shepard (*Anglo-American Oil Co., Ltd.*); the Rt Hon Emanuel Shinwell, M.P., P.C. (*Minister of Fuel and Power*); E. E. Soubry (*Standard Oil Co. of New Jersey*); and Lord Wakehurst, K.C.M.G. (*English Speaking Union*).

Members and guests present at the dinner included:

W. E. V. Abraham; E. Adler; D. Airey; D. Anderson; T. R. Appleby; K. Arter; R. I. E. Ashby; H. S. Aspinall; L. Aston.

J. R. Baddiley; H. Baker; H. R. Ballantyne; B. G. Banks; Sir Donald Banks, K.C.B., D.S.O., M.C., T.D. (*late Petroleum Warfare Dept.*); M. A. L. Banks; Dr C. T. Barber; Dr B. J. A. Bard (*Federation of British Industries*); Sir Charles Bartlett (*Vauxhall Motors Ltd.*); C. J. Bassett; W. D. Bayles (*Standard Oil Development Co.*); A. T. Beazley, M.B.E.; S. D. Bechtel,

Snr; A. W. Becke; H. E. Bedford; Dr G. A. Bennett (*Government Chemist*); J. P. Berkin; E. A. Berthoud, C.M.G. (*Ministry of Fuel and Power*); W. R. Beswick (*British Chemical Plant Manufacturers' Assoc.*); A. V. Billinghame; F. H. Billups (*Standard Oil Co. of New Jersey*); P. Bilton; T. R. Bird; Dr E. J. Boorman; F. C. Bowring; A. E. Braine; F. H. Braybrook; A. S. Bridgewater; F. L. Brooks; R. Brooks; S. Brown; T. Brown; A. Butler; Victor S. Butler (*Ministry of Fuel and Power*); W. Byron.

J. Cadman; Maj W. H. Cadman, M.B.E.; Donald B. Calder (*U.S. Petroleum Attache*); R. A. Carder; W. A. Carder; A. J. Carver; A. P. Chalkley; C. Chilvers; A. H. T. Chisholm, C.B.E.; W. P. Christensen; F. H. Coe; C. H. Collins; H. T. Collinswood; Capt D. Comins, M.C.; Sir Guy Cooper, M.C., D.C.M.; W. G. Corfield; L. G. Cowen; H. W. Cremer (*Institution of Chemical Engineers*).

A. Frank Dabell; G. M. Davies; Dr H. M. Davies; S. Day; H. D. Demoulins; C. F. Dennis; D. A. C. Dewdney; W. A. Dickie; M. B. Donald (*University College, London*); J. W. Drinkwater.

E. H. O. Elkington; Dr H. J. T. Ellingham (*Royal Institute of Chemistry*); Sir Charles Ellis (*National Coal Board*); Dr E. B. Evans; E. Evans-Jones; Sir Hubert Heath Eves.

V. Z. de Ferranti (*Institution of Electrical Engineers*); Prof G. I. Finch, M.B.E. (*Imperial College*); C. Fleming; Dr P. H. Frankel; A. Franks (*Oil Distributors' Emergency Council*); Wm. Fraser.

S. Garcke, C.B.E. (*Dennis Bros. Ltd.*); F. L. Garton; N. A. Gass; H. S. Gibson, C.B.E.; R. B. Godfree; C. Goodacre; P. M. Griffiths; W. Robt. Guy.

J. E. Hall; J. R. Hall (*Standard Oil Development Co.*); Sir Frederick Handley-Page, C.B.E. (*Handley-Page Ltd.*); E. W. Hardiman; Dr P. E. Hardy (*Standard Oil Development Co.*); Sir Harold Hartley, K.C.V.O., C.B.E. (*British European Airways*); R. Hayes; A. Healey; Sir Ian Heilbron, D.S.O. (*Scientific Advisor to the Cabinet*); Sir Patrick Hennessy (*Ford Motor Co., Ltd.*); E. LeQ. Herbert; Chas V. Hill; R. D. Hill; Walter L. Hill; Dr E. H. T. Hoblyn, M.B.E. (*British Chemical Plant Manufacturers' Assoc.*); Harold Hobson (*Central Electricity Board*); Sir Harold Howitt, G.B.E., D.S.O., M.C. (*Peat, Marwick, Mitchell & Co.*); K. C. Hunt; W. H. Huxley; H. Hyams; R. A. Hyslop.

H. Jagger; J. A. Jameson, C.B.E.; W. F. Jelffs; W. E. Jenkins (*Petroleum Board*); A. E. Jones; H. F. Jones.

Walter Kay; Peter Kerr; D. King-Farlow; R. W. Knight; C. W. Knighton; A. D. Koeleman.

R. P. Langston; T. F. Laurie (*Petroleum Board*); G. H. Lee; N. W. S. Lewin; R. I. Lewis; E. D. Lindrop; Prof R. P. Lindstead, C.B.E. (*Chemical Research Laboratory*); Sir Ben Lockspeiser (*Chief Scientist, Ministry of Supply*); J. E. Lytle.

I. McCallum; C. F. McCue; A. D. Maclean; E. C. Masterson; Niels Matheson; D. I. Maxwell; F. Mayo; Brian Mead (*Standard Oil Co. of New Jersey*); C. M. Merrick; W. G. Miller; M. Milne-Watson (*Gas Light & Coke Co.*); C. E. Mold; Group Capt A. P. Morley; Dr Frank Morton; F. A. I. Muntz; J. D. Murch.

Prof D. M. Newitt, M.C. (*University of London*); Sir Thomas Nicol, K.B.E.; E. W. Noble; G. Noble; Prof R. G. W. Norrish (*University of Cambridge*).

A. R. Ogston; T. C. Owtram.

A. C. Palmer; J. S. Parker; K. Parsonage; J. M. Pattinson; D. S. Paul; A. W. Pearce;

W. A. Peters; J. E. Pollock; J. L. N. Pollock; R. H. Porters; A. F. Pott; H. E. F. Pracy.

Major-Gen R. S. J. Ransome; Señor Jorge Reca; Prof E. K. Rideal, M.B.E. (*The Royal Institution*); Dr K. E. W. Ridler; Prof A. L. Roberts (*University of Leeds*); A. W. Robinson; J. B. Robinson; Col M. Robson, T.D.; H. W. Rocke; John Rogers; R. B. Rogers; C. G. A. Rosen (*Caterpillar Co.*); A. F. Ruthven-Murray.

D. W. Scott; E. Cooper Scott; G. H. Scott; George Sell; H. N. Short; Sir Oliver Simmonds (*Royal Aeronautical Society*); Brig G. A. Sims, C.B.E. (*War Office*); L. Sinclair (*Petroleum Board*); D. G. Smith; Sir Frank E. Smith, G.C.B., G.B.E. (*Institute of Physics*); Geoffrey Smith; J. A. Smith; Sir Rowland Smith (*Ford Motor Co., Ltd.*); C. S. Snodgrass; C. A. P. Southwell, M.C.; C. E. Spearing; W. H. Stevens; Brig R. S. G. Stokes; J. Sverdrup.

Dr T. Tait; P. Thistleton; Dr F. B. Thole; O. F. Thompson; E. G. Thorn; G. H. Thornley; E. Thornton; T. C. G. Thorpe; F. Tipler; Dr O. Tokayer; G. Trail; D. F. Tripcony; James Turner (*National Farmers' Union*); S. D. Turner; R. R. Tweed; Sir William Twysden, Bt (*late Petroleum Warfare Dept.*); Lt-Cdr E. Tyrrell.

Major-Gen A. R. Valon, C.B., O.B.E., M.C. (*British Council*); Prof W. F. D. Van Dijk; J. W. Vincent.

W. F. Wackrill; Dr O. H. Wansbrough-Jones (*War Office*); W-Cdr T. Muir Warden; A. Waterston; Prof H. E. Watson (*University College, London*); H. L. West; Dr F. R. Watson; R. H. Wetherall; A. T. White; W. W. White; E. H. Wild; John Spencer Wills (*British Electric Traction Co., Ltd.*); G. N. Wilson; C. S. Windebank; E. R. Wood; W. A. Woodrow; M. D. N. Wyatt.

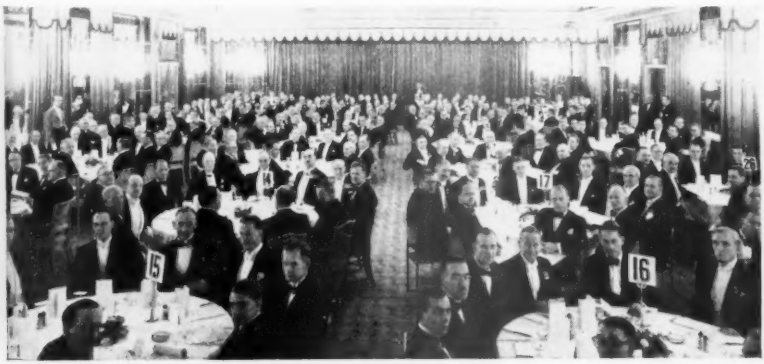
C. R. Young.

The toasts of "His Majesty the King" and of "The President of the United States" were honoured.

"MR ROBERT PRICE RUSSELL"

THE CHAIRMAN, proposing the toast of "Mr Robert Price Russell", said: Our president, Sir Andrew Agnew, is abroad and he has asked me to express his great regret at not being with us to-night.

This is the first occasion on which the Institute of Petroleum has had the opportunity of entertaining to dinner its Cadman Medallist. To have as our guest so distinguished a personality as Mr Robert Price Russell is a source of pride and pleasure to us all, and I bid you, Mr Russell, a most hearty welcome on behalf of our Institute and our friends here assembled. This gathering represents all branches of our industry. Its guests, among whom we particularly welcome our Minister of Fuel and Power, extend its range into many other walks of life. It thus betokens the comprehensive tribute which we wish to pay to you, Mr Russell, for your many-sided activities and attainments, as a notable figure in American life, as an old friend of many of us here, and as a good friend to all that is best and most progressive in the world petroleum industry. It is, I



know, quite superfluous to remind a gathering such as this of the historic links which bind so closely together our guest's country and our own industry. But it so happens that I have recently returned from a visit to the United States where I had been invited to speak on "International Aspects of the Petroleum Industry of the Future" to the World Conference of the American Institute of Mining and Metallurgical Engineers, who later honoured me with membership of their Institute. As I travelled round, both on the East and West coasts, I found everywhere not only that hospitality which is traditionally American, but the liveliest interest in our progress and problems. Well, Mr Russell, this dinner is in your honour but your record of public duty is such that I know you will not mind sharing some of that honour with your industry as a whole.

Gentlemen, in inviting Mr Russell to deliver our Cadman Memorial Lecture this year, we had particularly in mind our main object in establishing these lectures, which I think I might briefly recall.

In 1941, on the death of Lord Cadman, a group of us decided to perpetuate his memory by arranging for these periodic lectures. We wanted to commemorate a great friend, a great oil man, a great exponent of the scientific approach to every problem, a convinced believer in the international scope of our industry with warm affinities with America. When he entered the industrial world of petroleum shortly after the first World War he brought with him, and extended into it, his original scientific and technical knowledge and training. In their application to the practical problems of our industry lay his chief pre-eminence, and just as science and knowledge know no frontiers, so his efforts were always to promote a sane and honest international outlook in the industry, petroleum everywhere being regarded as a store of energy to be conserved and used as part of a well-conceived plan. In his own words: "Co-operation between nations and international forces there must be in some form or another if we are not to squander the world's heritage."

In addition to his many interests in other scientific, technical and public concerns, Cadman was the only man so far to be twice president of our Institute. It was therefore natural to have this Institute associated with the commemoration of his name; and so came to be founded the series of lectures of which we had so notable an example from Mr Russell yesterday, and the Cadman Medal bestowed on the lecturer as one of the highest honours in the gift of the Institute.

In Russell we have a mind which marches well with Cadman's. His outstanding position in the petroleum industry is well known, particularly his interest in, and contributions to, scientific research. Even Cadman's great interest in civil aviation—perhaps his greatest interest outside the main channels of the petroleum industry—finds an answering chord in all Mr Russell did for the Allied supplies of aviation fuels during the last war. To ensure the practical application of his scientific researches, he undertook war service of the most arduous nature in the Pacific areas; duties not altogether necessary for the chairman of his nation's Petroleum Warfare Division but altogether typical of Bob Russell—if I may use the name by which he is so well known across the Atlantic and among his many friends in Britain.

In his career, Russell has naturally received many high honours. They include the award by President Truman of the Medal for Merit—America's highest civilian award—as well as the Medal of Freedom for outstanding services with military operations in a theatre of war. Last year he was awarded the American Institute of Chemists Gold Medal. It is our hope

that our Cadman Medal, presented yesterday, will rank among these trophies as a mark of the very high esteem in which we, his friends and colleagues on this side of the water, hold him.

In token of which I now ask you to drink to the health of our honoured friend, Mr Robert Price Russell.

The toast was enthusiastically honoured.

The Chairman (right) and the Guest of Honour enjoy a lull during the reception

MR ROBERT PRICE RUSSELL, responding to the toast, said:

I cannot hope adequately to express my appreciation of the tremendous reception and of all the friendships that I have enjoyed during these past days. I can only say that I am completely overwhelmed. The international friendships which, as Sir William has pointed out, characterize the relationships of oilmen with one another and make possible events such as this one, have indeed paid a heavy dividend to both our countries.

Closest in our minds, perhaps, are still our wartime experiences involving the scientific planning and operational co-operation which did not recognize the Atlantic as a barrier. It was quite in the ordinary course of events to find Englishmen working in American laboratories and in American plants, and Americans working in England. Everything was common property and everyone purloined from everyone else. I recall a conversation I had during those days with Prof Garner and Sir Donald Banks, in which we agreed that we were working in the delightful environment in which one could steal anything from anyone. Every idea, every technical achievement, every bit of laboratory or plant equipment, and every tanker, were looked upon and operated as common property. I am sure that no one ever stole more ideas from more people in less time than I did [laughter] and when our ideas were purloined we regarded it as a terrific compliment. But since the war, some of these habits have had to be corrected!

To-night I see before me scores of men with whom I had the pleasure of working on a number of joint wartime problems. I am not going to try to point my finger at each of these men, but I would like to cite a few examples. Certainly one of the most important of the co-operative accomplishments rests in the story of 100 octane aviation gasoline. First we had to discover not what the laboratory technicians thought was 100 octane but what the aircraft engine recognized as 100 octane. I can well recall the frenzied cabling back and forth across the Atlantic which was necessary in order to co-ordinate and apply immediately the

bits of information as they became available in Britain and in the States. The job was done, and certainly no one man can take the credit, although just before I stood up I counted 19 people here to-night whose individual contributions indeed were major ones.

Just before Pearl Harbour my organization was given the job of developing a certain type of small incendiary bomb. At that time we knew nothing whatever about incendiaries, and I despatched an urgent cable to my friend Prof Garner. When he finally staggered down the gang plank of a tiny freighter after a stormy Atlantic crossing, he certainly was a welcome sight. Prof Garner did not know much more about our particular incendiary problem than we did, but he had hard-earned knowledge in many closely related fields. I am sure that our final development of the M-69 incendiary bomb would have been delayed at least three critical months if it had not been for his contributions.

In a somewhat lighter vein I might mention certain outstanding services performed by Mr Victor Butler. On one occasion his British accent and broad shoulders accomplished wonders. One hot October day it became necessary for the Russell household goods to be moved from a country house in New Jersey to a New York apartment. Neither a removal van nor movers were available, so the Russell goods and chattels were hauled to New York in a decrepit station wagon. There Victor, who happened to be in New York on urgent business that day, in the late afternoon was impressed for duty in unloading and carrying. The fee was two ounces of Bourbon whisky after each trip between station wagon and apartment—not paid in advance but collected on delivery! But it was not only his strong back and willing hands that helped. We could ordinarily not have had the use of the passenger elevator, but on hearing Mr Butler's accent, the elevator operator—a Jamaican of somewhat dusky hue—said: "Now I can be of help to my own people!" and permitted the Butler-Russell task forces to operate at will through the lobby and up the passenger elevator. Both of us, incidentally, were reasonably upright characters at the end, in spite of the numerous trips between decanter and station wagon [loud laughter].

The Chairman of Council (right) *refreshes his memory on a point while the Minister of Fuel and Power ponders*

Major compromises were often necessary on both sides in order that enough material could be produced, transported and made available where needed. The creation of joint common specifications not only for

petroleum products but for thousands of other vital items as well, posed serious problems in Britain and in the States. The problems were solved without bitterness. I think the spirit which characterized our operations was expressed very neatly by Mr Churchill on one occasion when he said: "We will call petrol gasoline, but damned if we will call a lorry a truck!"

At the Chairman's table (left to right, facing the camera) *are: R. P. Russell, Sir William Fraser, the Rt Hon Emanuel Shinwell, H. C. Tett, Prof Alan Nevins, and Lord Wakehurst*

I should like now to consider briefly with you some important problems of peace which, in my opinion, must quickly be solved if tranquillity is to be restored in the world. I mention them before you because I am convinced that our technical staffs can contribute importantly to their solution.

One problem which affects the whole world to-day, and is becoming increasingly serious with each month, is that of supplying adequate quantities of food. The problem here is not a temporary one brought about by the war. Its roots lie much deeper, involving such factors as the rapid growth of populations and the expansion of industrial communities. Our rural populations are declining, yet if everyone is to have enough to eat, the land must be made to yield the same or more food but with less and less labour for planting, cultivation and harvesting.

Here is a situation in which our research, development and engineering organizations can render important service. Let me give you a few examples of situations which actually exist. The Latin-American countries contain some of the richest soil and most ideal climate for agriculture that exist anywhere in the world, but their productivity is low. A major problem is weed control, which occupies the greater part of the energies of farm labour throughout this enormous area. In fact, the best land cannot be used for agriculture since weed growth is so extremely rapid that organized agriculture is impossible. The people actually rely on drought afflicted areas where for several months of the year it is possible to burn back jungle growth and grow food crops.

We could help decisively to aid conditions throughout these countries by making new products, such as our synthetic weed killers, available to our neighbours and, more important, by sending to them the trained technical people needed for working out proper applications under varying local growth conditions. We could help in the important task of educating national technicians so that they, in turn, could train the farmers. In this way, a substantial increase in the world food supply could be quickly achieved.

Recently, I was privileged to see what was probably the first major field trial under Central and Latin-American conditions of some new synthetic weed killers when they were applied to a major Latin-American crop—rice. I saw a large rice field under study by the Inter-American

Institute of Agricultural Sciences in Costa Rica. The entire field had been as carefully hand weeded as possible under existing conditions of labour availability. But one end of the field had received a single application of a weed-killing agent which, I am sorry to say, was not made from petroleum hydrocarbons. The difference was spectacular. The specially treated end of the field was green and luxuriant while the rest of the field was weed choked and had the brown and scraggy appearance of most of the other rice fields I had seen in that area. The additional number of sound rice grains per stem in the treated section would impress even the most casual observer.

Another food crop which, in my opinion, could benefit greatly from the attention of technical groups, is chocolate. A world shortage of chocolate and cocoa exists and experts predict that this shortage will continue for an extended period. I wonder how many of you have ever seen cacao being harvested? I am sure you would be amazed at the techniques employed. They could best be termed relics of ancient folk culture. Between the time the cacao pod is whacked off the tree with a machette, and the time the finished bean is ready for shipment, a third of the crop is often lost. The type of equipment customarily used for cleaning and drying is of the most primitive kind.

I was glad to learn that the problem of cacao harvesting, cleaning and drying, has, in fact, recently received the attention of a small group of fertile-minded, enterprising development engineers. This small group of men, fortunately unspoiled by too much knowledge of the subject, in the course of a relatively few months succeeded, in a large-scale pilot plant, in greatly shortening the time between harvesting of the cacao pod and the shipment of the finished bean. I was told that the technique developed resulted in a major reduction of crop losses and in improved output quality. The time taken between harvest and shipment was reduced from 10 days to less than 48 hours. Not only is modern equipment needed to put this technique into general operation, but trained personnel must be provided to educate Latin-American nationals in the new processes. Similar applications of sound engineering principles would undoubtedly result in corresponding improvements in the finishing and processing of other important food crops.

I realize that in mentioning the subject of exporting technological skill at the present time, I am treading difficult ground. For the next several years, every industrial research, development and engineering organization in both Britain and the United States must meet its pressing peacetime requirements with far fewer trained personnel than are really required. During the war years we accumulated a tremendous backlog of research and development jobs essential to our own industries and to the national welfare. Our technical manpower must be stretched to the utmost until such time as our universities and technological institutions once more provide us with an adequate number of well-trained men and women and until we are able to build new facilities in which to house them. But in addition to meeting our own needs with depleted staffs we must, in my opinion, somehow find a way to take care of at least some of the requirements of other countries friendly to us.

By giving a helpful technical hand, we can prove to all the world that our system of democratic, competitive enterprise not only works, but that it can contribute more to the well-being of people than any other system thus far devised. The people of many countries are eager to-day for a way of living they cannot now provide through their own skills, and if they do not receive assistance from us they will turn to inferior substitutes with probable unfavourable

accompanying political developments. In our own enlightened national self-interest we must assist actively in solving the economic problems of our neighbours. I am sure that in this way the research, development and engineering organizations of our two countries can pay enduring service to the cause of lasting peace.

"THE PETROLEUM INDUSTRY AND THE INSTITUTE OF PETROLEUM"

THE RT HON EMANUEL SHINWELL, M.P., P.C. (*Minister of Fuel and Power*), proposing the toast of "The Petroleum Industry and the Institute of Petroleum", said: For reasons that may be obvious to most of you who are present I have, to use parliamentary language, "for purposes of greater accuracy", committed my speech to writing, and I shall thus avoid, in spite of great temptation, any possibility of risk [laughter].

You have conferred on me the high distinction of proposing the toast of the petroleum industry. This gives me special pleasure because you are taking the opportunity of paying a well-deserved tribute to a distinguished American, Mr Russell, on the occasion of his becoming the second Cadman Memorial Medallist.

I was particularly interested in the first part of Mr Russell's observations. He said something about "common property" and, be it noted, confiscation of ideas [laughter]. As I listened, I wondered whether I had not gate-crashed into the wrong function!

As I came into the hotel, I learned that yesterday Mr Russell in a brilliant lecture—which I regret not having heard but which I hope I shall have an opportunity of reading—had indulged in some conjuring tricks. If ever he finds himself out of employment I beg him to enrol himself in the nondescript army of British politicians [laughter]!

Oil is a comprehensive and fascinating subject. It is also a commodity of vital importance to the economic life and development of the whole world. I understand that in his lecture, Mr Russell estimated that 30 per cent of the world's energy is now provided by petroleum as compared with 23 per cent in 1938. In Great Britain, of course, the contribution of oil is rather less, but when the present coal-oil conversion plans have been completed, it will provide about 10 per cent of the country's energy as compared with about 6½ per cent at the present time. You may be interested to learn how coal-oil conversion is proceeding. The consumption of black oils in the year

Left to right—*John Spencer Wills, A. Franks, Sir William Twysden, Prof F. H. Garner, Sir Donald Banks*

May 1945 to April 1946 was 1,960,000 tons. In the year just ended, it was 2,580,000 tons, representing an increase of 620,000 tons which, assuming the very low equivalent of 1·6 tons of coal to 1 ton of oil, makes a saving of coal of 1 million tons in a year.

After the present plans are completed, which we hope will be in mid-1948, the consumption will be 7 million tons a year. This increase of 5 million tons a year represents a saving of about 8 million tons of coal a year which, though small in comparison with the country's coal production is, undoubtedly, a substantial gain. This project has been encouraged by the wide knowledge and experience of the oil industry and the readiness of its technicians to co-operate with the

Government. There are many bottlenecks that emerge when attempts are made to treble our consumption in the comparatively short period of two years but, together with the oil industry, we are grappling with these difficulties and I have reason to believe that we shall achieve our objective.

However, it has been found necessary to suspend further authorizations for conversion from coal to oil until we can see the position a little more clearly. It would obviously be a mistake to allow industrialists to go ahead and spend large sums of money to enable them to burn oil if coal, which is a cheaper fuel, is available in sufficient quantities and unless we felt reasonably sure that the oil will be there when we need it. We shall, however, keep the position under review and will naturally do everything possible to provide the maximum amount of fuel, whether oil or coal, for industry and for the domestic consumer.

But co-operation between the oil industry and the Government is not limited to this particular field. During the war a remarkably close and successful contact was developed and I expect, as I believe the industry does, that this co-operation will continue. Moreover, I earnestly hope that this co-operation will not be limited to British companies and the British Government. During the war an almost complete pooling of oil resources took place between ourselves and the United States, and the British and American Governments, with their respective oil industries, were in constant consultation. That was an achievement of which everyone concerned has a right to be proud.

With the coming of peace, conditions have naturally changed and the international petroleum trade is once again becoming competitive. But there will always remain many problems of mutual interest to all the countries concerned in the production and availability of oil. It was because we recognized this fact that in September 1945 I had the privilege of signing, with representatives of the United States led by my good friend Harold Ickes, the Anglo-American oil agreement. As most people here are aware, this agreement enunciates certain principles which the two Governments feel are essential to the orderly development of the international petroleum trade, and it creates an Anglo-American Petroleum Commission amongst whose functions will be the convening of an International Petroleum Conference representing all the nations concerned, in order to discuss the phases of such an orderly development. Because of the intervention of more urgent matters, this agreement has not yet been ratified by the United States Congress but it is expected that the case in support of ratification will soon be heard. I understand that the Senate Foreign Relations Committee has just started hearings on the agreement.

The Institute of Petroleum was founded in 1913 and is designed to encourage and co-ordinate the study of petroleum and allied products in all their aspects. This is certainly a very wide field but so are the ramifications of the petroleum industry. I am particularly interested in its activities regarding research and education. In the matter of technical education this country is still deficient and more substantial progress must be made if we are to hold our own. The oil industry has already contributed handsomely to the universities, and no doubt it will continue to do so, and while the shortage of qualified teaching staff at the present time makes immediate expansion difficult, I hope that a co-ordinated drive will be made in this direction as soon as the abnormal situation caused by the war has disappeared. I have in mind not only training in subjects that are directly concerned with petroleum but with the wider sciences of chemistry, physics, chemical engineering and

geology. Modern science presents exceptional opportunities for this and other industries. We already have great achievements to our credit but more are yet to come. Nevertheless, we shall fall behind, and our industrial development will be retarded unless we promote the utmost co-operation between the representatives of industry, of science and of the Government. We must, without delay, summon to our aid all the available technical and scientific knowledge in the country. Without that co-operation we shall assuredly fail to restore and improve the social and industrial position of our people.

Under the Act setting up the Ministry of Fuel and Power I, as Minister, am charged with the duty of securing the effective and co-ordinated development of coal, petroleum and other sources of fuel and power, and of promoting economy and efficiency in the supply and use of fuel and power. As shewing my practical interest in this matter I have decided to appoint a Scientific Advisory Council to the Ministry of Fuel and Power [applause]. May I say that for a long period of years I have had this project in mind. I first conceived the notion when I was Secretary for Mines in 1924. I had hoped to develop the idea in 1930 but was unable to do so. However, because scientific research including research into fuel technology in all its aspects was concentrated in the Department of Scientific and Industrial Research, I was unable to avail myself in the Mines Department of all the scientific knowledge I desired to utilize. There are many problems associated with fuel and kindred subjects that still await solution and I am certain that the existence of such a council will prove to be a great benefit. I hope very soon to make a further announcement on the personnel of this Advisory Council.

Before asking you to honour this toast, I should like to pay a tribute to Sir Andrew Agnew, the President of the Institute, who is unable to be present at this function owing to urgent business resulting, so I understand, from a practical example of international co-operation in oil. That is no reflection on our chairman to-night, Sir William Fraser, an old, valued and controversial friend of mine [laughter]. As Chairman of the Petroleum Board and of the Trade Control Committee, Sir Andrew Agnew has borne heavy responsibilities. We are all grateful to him for his untiring efforts and for the spirit in which he has led the industry side of the Government partnership in oil, without which I doubt whether we should have emerged from the anxious days of war.

Left to right—F. H. Billups, H. W. Rocke, Col S. J. M. Auld, Victor S. Butler, Sir Harold Hartley, Sir Ben Lockspeiser, Sir Frederick Handley-Page, and Donald B. Calder

I now have much pleasure in giving you the toast of "The Petroleum Industry and the Institute of Petroleum", coupled with the name of Mr Hugh Tett, Chairman of Council.

MR HUGH C. TETT (*Chairman of Council*), responding, said:

It is a great privilege on behalf of the Institute of Petroleum to welcome here to-night the Minister of Fuel and Power and to thank him for the very gracious way in which he has proposed this toast. We realize how difficult it is in these days for a Minister of the Crown to find the time to attend social functions, however important or pleasant those functions may be. Of the importance of this function I think there can be no doubt. In giving this dinner in

honour of Mr Russell, the Institute is very conscious of the honour which he has conferred upon us by crossing the Atlantic to deliver the Cadman Memorial Lecture [applause].

Mr Shinwell can never be accused of hiding his true thoughts or feelings behind false and honeyed words. I think, therefore, I am right in assuming that his speech can be taken as an indication that he has found this function pleasant as well as important. I can assure him that his presence here, together with Sir Donald Fergusson and others of his colleagues of the Ministry has added very greatly both to the importance and pleasure of the occasion for all of us here.

We are all very sorry that our President—Sir Andrew Agnew—was prevented from being with us to-night, particularly as this is the first dinner of the Institute since 1938. We feel that we are singularly fortunate in that he who led our industry through the war years should have consented to be our President last year, and again for this coming year of Institute activity. His experience and his wisdom have been invaluable to us in the past and will continue to be so in this difficult and unfortunately protracted period of translation from war to peace.

In the absence of our President, your Council felt that it would be appropriate that the chair should be occupied by a close colleague and associate of the late Lord Cadman, and we also feel that it is a particularly happy arrangement that Sir William Fraser, the first Cadman Memorial Medallist, should preside at a dinner honouring the recipient of the second Cadman award. Sir William, may I express our thanks to you for acting as our Chairman to-night.

The members of the Institute will, I know, expect me to welcome on their behalf the many guests we have here to-night, both those who are the official guests of the Institute and those who are the private guests of our members.

I should like to welcome specially Professor Nevins who is a good friend of Britain and represents the U.S. Embassy. It may not be known to all of you that Prof Nevins was associated with the production of that excellent little book which was handed out to all the American troops and which may have had something to do with the exemplary manner in which they behaved in this country [laughter]. We also have with us Lord Wakehurst, President of the English Speaking Union, and both have contributed a very great deal indeed to the cause of Anglo-American friendship. We feel that Mr Russell, in accepting the Cadman award, has strengthened the very close bonds of friendship which exist between our two countries and especially between oilmen here in Britain and on the other side of the Atlantic.

We are also honoured by the presence of a very large number of representatives of the Services and of Government departments. We have always enjoyed their full co-operation in the labours of the industry and of the Institute. I was the guest a few days ago at the annual dinner of the Chemical Engineering Group of the Society of Chemical Industry and being myself not a chemical engineer, or for that matter a chemist or even an engineer [laughter] but merely a humble ex-physicist, I might, had I not been among friends, have felt rather like those poor ducks in Mr Russell's film trying to swim in water that had been "got at" by chemical engineers, and made wetter than it should have been! However, I was made to feel very much at home by a most inspiring speech delivered on that occasion by the guest of honour, Sir Ben Lockspeiser, Chief Scientist to the Ministry of Supply, whom we are glad to have with us to-night. Sir Ben spoke with very deep knowledge and with the greatest optimism of the part that

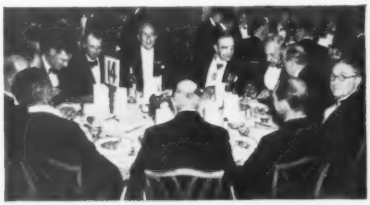
petroleum and petroleum chemicals can play in restoring the prosperity of Britain. If there be any here who are pessimistic about the future of our industry or of Britain, I recommend them to read that speech. I may add, that like the ducks in Mr Russell's film, the guests found no shortage of wetness. I hope that out guests to-night are similarly situated. I would also add that, like the ducks, the guests also succeeded in getting away under their own power!

We also welcome Sir Robert Robinson, President of the Royal Society, and the presidents of a number of other learned societies and the many distinguished men of science who are here to-night.

At the risk of offending some of our very distinguished guests, whom I cannot mention all by name as there are so many of them, I do feel that those of you who were at Mr Russell's lecture yesterday will agree with me that I should mention two people who contributed greatly to the success of that lecture. I want to welcome Dr Hardy who gave the demonstrations and Johnny Hall, who not only did the projecting of the lantern slides and films but also made all the lantern slides and most of the films himself [applause]. I must also mention the staff of the Institute who have put so much hard work into this occasion and the lecture yesterday and are largely responsible for the success of both functions.

We also have as our guests many executives from our own industry, including a number from America, who are always specially welcome at any function of the Institute of Petroleum. We also have a large number of leaders of other industries. It would, I think, be difficult if not impossible to think of any other industry which is not either a customer or a supplier of the oil industry. Many are both customer and supplier. We believe that the most intense and vigorous co-operation is necessary between our industry and those which it serves.

There is to-day a great wealth of scientific achievement and development, accumulated during the war years, awaiting application to the peaceful needs of mankind. Mr. Russell gave us yesterday a glamorous but nevertheless realistic picture of some of this development. There is an enormous potential reservoir of knowledge and experience which cannot be applied immediately. It is, so to speak, dammed up by the shortages which are inevitable after a war. The application of this knowledge and experience to increase the efficiency of industry, of agriculture and transport, and to supply new raw materials will assist in reviving our whole economy and will raise the standard of living here and throughout the world.



Left to right—S. D. Turner, Capt D. Comins, D. S. Paul, James Turner, Prof G. I. Finch, C. A. P. Southwell, H. D. Demoulins

These advances can, however, only be put into rapid and effective use by team work within each industry and between one industry and another. We hope that the Institute of Petroleum will play an increasingly important part in helping to arrange discussions between our industry and others to our mutual advantage.

Mr Shinwell has spoken of his interest in research and in technical education, and of our pressing technical manpower shortage. We are considering in the Education Committee and the Research Committee of the Institute what we can do to contribute to the

solution of this long-range problem. Graduate scholarships at universities provide no solution since we hear there is difficulty in filling those that already exist—a situation which makes many of us very conscious of having been born too soon! We believe, therefore, that it may be more useful, rather than adding to the number of graduate scholarships, to seek ways and means of increasing the exchange of senior scientists between industry and universities. Our own industry provides some brilliant precedents in this connexion.

The first Lord Cadman, whose memory we are honouring, and whose son, the present Lord Cadman, we welcome here, was a pioneer as a professor in the teaching and training of industrial scientists. He subsequently demonstrated most successfully that men of science are not always necessarily completely devoid of commercial sense and business acumen [applause]. Mr Russell was also a university professor and an academic scientist of distinction before he turned his talents to industry and built up one of the largest industrial research organizations in the world. On the other hand, our immediate past-president, Prof Garner, has reversed the process and is demonstrating that a scientist who has been successful in industry for 21 years can also be a shining success as a professor [hear hear].

The days have gone when the industrial scientist was kept apart in a small back room and when commercial and technical development could be separated. Scientists have become to some extent industrialists, and leaders of industry certainly need to have very deep understanding of the applications of new techniques in their business.

With commendable foresight the Institute, some ten years ago, laid plans to broaden its membership, and changed its name. Previously it was called the Institution of Petroleum Technologists, a very severe test of post-prandial pronunciation! We regard it as our job in the Institute to provide not only for the dissemination of developments in petroleum science but also to provide for the exchange of knowledge and experience throughout the oil industry in all its many phases. We believe our industry has been forged into its present greatness by fierce competition tempered by sensible co-operation in the energetic application of organized research and development.

All of use here, Mr Minister, hope to see that co-operation continue and we all welcome your announcement of the forthcoming formation of a Scientific Advisory Council to the Ministry of Fuel and Power. There may, however, be some few aggressive members here who also look forward somewhat impatiently to the revival of our prewar battles with each other [hear hear].

We feel that we are fortunate in having one Government department for the whole of the fuel industries. We are all very conscious of the vital importance of coal to Britain, but it seems to me, after listening to Mr Russell yesterday, that coal and oil in the future are not going to be as competitive as they were sometimes thought to be in the past. We all wish Mr Shinwell every success in his vitally important and difficult task. We hope and believe he will find the oil industry can pull together with coal, gas and electricity in the service of British industry.

No one knows better than the Minister from personal experience that oilmen are notoriously of meek and modest disposition [laughter]. If we ever seem otherwise, it is because we are truly, and we think justly, proud of the industry which we serve.

I thank Mr Shinwell very cordially for his speech and the members of the industry, the Institute, and our guests for responding so generously to the toast.

WORLD'S CRUDE OIL OUTPUT

The 1946 Report of the Royal Dutch Petroleum Company gives the following figures for the world's production of crude oil, including natural gasoline, in 1945 and 1946:

	In 1000 Metric tons		In 1000 barrels	
	1946	1945	1946	1945
United States	248,030	245,000	1,848,600	1,825,700
Venezuela	56,760	47,310	388,900	323,700
U.S.S.R. (incl. Sakhalin)	22,500	20,500	164,000	149,000
Iran	19,460	17,110	146,300	128,700
Saudi Arabia	8,200	2,900	60,300	21,300
Mexico	6,940	6,130	48,400	42,900
Iraq	4,700	4,600	35,000	34,400
Roumania	4,370	4,830	32,400	35,800
Colombia	3,180	3,200	22,400	22,700
Argentina	3,000	3,300	20,800	22,900
Trinidad	2,970	3,070	20,200	20,800
Peru	1,770	1,940	13,500	14,800
Egypt	1,280	1,340	9,000	9,400
Bahrein	1,100	1,000	8,000	7,300
Canada	980	1,090	7,600	8,500
Austria	850	450	5,700	3,000
Kuwait	800	—	5,900	—
Hungary	690	660	5,300	5,000
Germany	650	550	4,500	3,800
Ecuador	320	350	2,400	2,700
Neth. E. Indies	300	1,090	2,100	7,600
Brit. Borneo	300	300	2,100	2,100
India and Burma	290	360	2,200	2,600
Other Countries	860	750	6,100	5,400
Total	390,300	367,830	2,861,700	2,700,100

REFINERY ENGINEER FOR IRAQ

In connexion with the Government oil refinery which is to be erected at Baiji, Iraq, the Iraqi Government is in need of an oil refinery engineer with a thorough knowledge of constructional works and problems. He should also possess considerable administrative capabilities and should have at least ten years practical experience in refinery work and operation. The successful applicant will be responsible to the Government that the constructional work is carried out in accordance with the contract terms.

The terms offered for the post are a contract for three years at a monthly salary of £150 to £200, according to qualifications, plus a cost of living allowance of £24 per month. Details, and a copy of the Iraqi Government's standard contract form, are obtainable from the Crown Agents for the Colonies, 4 Millbank, London, S.W.1. Envelope and letter should be marked M/N/18156.

COUNCIL COMMENTARY

THE Council Meeting on June 4 was well attended and opened with a sad, solemn rite with members standing in silence as a tribute to the late Sir Thomas Holland who had died suddenly and unexpectedly since the last meeting. Mr Dewhurst paid an eloquent and well-merited tribute to his outstanding work and personality.

The Agenda for the Meeting had been curtailed because the Cadman Memorial lecture was to be held the same evening, but even the abridged agenda proved too much—largely owing to the lively interest shown by members in a proposed design for the Institute Crest. It was indeed enlightening to hear eminent petroleum technologists on the subtleties of Art and design and the subsequent voting was so close that the matter was referred back to a sub-committee!

The By-Laws Committee submitted and obtained endorsement of the copy of the revised By-Laws to be laid before the members on July 24 for acceptance. As there are 93 such By-Laws all hammered out with meticulous care and carrying solicitorial blessing, it can well be imagined that the By-Laws Committee have had a long and arduous task to get this document prepared.

REDWOOD MEDAL AWARDED TO H. S. GIBSON

THE Redwood Medal of the Institute of Petroleum has been awarded to H. S. Gibson, C.B.E., M.A., M.I.Mech.E., F.Inst.Pet., general fields manager Anglo-Iranian Oil Co., Ltd., Abadan, for his unique work on the production of petroleum.

H. S. Gibson, C.B.E.

Established in 1921 in honour of Sir Boverton Redwood, Founder President of the Institute, the Redwood Medal is awarded "as and when desirable but not more than once in each year, to a petroleum technologist of outstanding eminence, irrespective of nationality or membership of the Institute." Only seven previous awards have been made since the medal was instituted, the last being in 1938.

Mr H. S. Gibson served in the first World War in the York & Lancaster Regiment in France, Egypt, Salonica and Turkey, and was mentioned in dispatches. On demobilization in 1919 he went to Emmanuel College, Cambridge, until 1922, and obtained his Mechanical Science tripos B.A., proceeding to M.A. in 1930.

In 1922 he joined the (then) Anglo-Persian Oil Co. Ltd., as Production Engineer, being promoted to Production Superintendent in 1928, and to Production Manager two years later.

In 1932 Mr Gibson was appointed Assistant Fields Manager (Production); in 1944 he became Assistant General Fields Manager (Production) and in 1945 was made General Fields Manager.

He was awarded the C.B.E. in this year's Birthday Honours.

A Fellow of the Institute of Petroleum, Member of the Institution of Mechanical Engineers and of the American Institute of Mining & Metallurgical Engineers, Mr Gibson is the author of the chapter on "Scientific Unit Control" in *The Science of Petroleum*. He also contributed an article on "Multistage Stabilization of Crude" to *Petroleum Development & Technology*, 1940, (Amer. Inst. Min. Metall. Engrs.).

It is planned to present the Redwood Medal to Mr Gibson at meeting of the Institute of Petroleum in the 1947–48 Session. He will present an address on "The Production of Oil from the Fields of South-west Iran."

PROF GARNER AWARDED MEDAL OF FREEDOM

The Institute offers its congratulations to Prof F. H. Garner, O.B.E., immediate Past-President and Honorary Editor on his being awarded the American Medal of Freedom with Silver Palm. The citation reads:

"Doctor Frederic Horace Garner, United Kingdom, during the period of active hostilities in World War II, performed exceptionally meritorious service in the field of scientific research and development. An outstanding English authority on petroleum problems, he came to the United States, and by his great knowledge in the field of flame throwers, generated strong interest in their possibilities and fostered related developments that were a substantial contribution to Allied military successes."

THE ORGANIZATION OF INDUSTRIAL RESEARCH*

By ROBERT PRICE RUSSELL

THE subject I have chosen to discuss to-day is "The Organization of Industrial Research". In order to remain on familiar ground, I shall confine my remarks generally to the petroleum industry, and refer specifically to organized research as it has evolved in my own company. I believe, however, that the factors and conditions underlying the development of industrial research in this field apply in varying degrees to industry as a whole. For what they may be worth, I shall also add some items of research philosophy that my associates and I have evolved during some 20 years of research experience in a process industry.

So completely has it turned to research for guidance that to-day the petroleum industry is one of the leading employers of technically trained personnel. In 1937, the most recent year for which statistics are available, 21 qualified research workers were employed in the United States petroleum industry for every 1000 employees. The chemical industry employed 30 and the radio apparatus and gramophone industries employed 23 research workers for each 1000 total employees. It is to be expected that the figures for these latter industries should be higher than for petroleum in view of the more specialized character of their operations. In contrast, the coal industry during the same year employed only 2 industrial research workers for each 1000 employees and the iron and steel industries only $1\frac{1}{2}$. Although accurate figures are not available for the petroleum industry worldwide, it is clear that the size of the research staffs has increased considerably since 1937. I also know that many units of the industry would be utilizing even more research personnel and facilities if they were available.

The whole-hearted application of organized research has been, in my opinion, a major factor in enabling the petroleum industry to attain its present position. Radical improvements in locating oil, major advances in drilling and bringing oil to the surface, and revolutionary new processes to improve the yield and quality of desired products have enabled the oil industry not only to keep pace with the world's constantly growing demand for petroleum products, but have resulted in mounting improvements in quality without long-term price increases. For example, gasoline shockingly bad in anti-knock characteristics by to-day's standards sold at U.S. refineries 25 years ago for 14 cents a gallon. To-day the refinery sales price in the U.S. Gulf area for a superior quality gasoline is about 7 cents, or half the 1922 price for the inferior product. This reduction in cost was accompanied by a doubling of output, a radical improvement in quality, and a great increase in the unit costs of labour and material.

During recent years oil research scientists have discovered methods for obtaining from petroleum a wide range and variety of new products or of products which previously were derived from other raw materials. Synthetic rubber, many kinds of alcohols, fertilizers, solvents, insecticides, detergents, and numerous chemicals might be mentioned. There is already considerable activity in the United Kingdom in the new fields of chemicals based on petroleum.

* Lecture delivered before the Federation of British Industries in London on June 9, 1947.

Research Dividends

In my own company research activity began in 1919 with a group of 26 people. The avowed purpose was to formulate and carry out the minimum research and development programme which would make available to our operating affiliates processes and techniques which would enable them to make, at lowest possible cost, products equal or superior in quality to those sold by competitors. Our staff to-day includes 2456 technologists, engineers, assistants, and clerical personnel, all working exclusively on research and development projects. In addition, we employ several hundred people who work on laboratory phases of direct operating problems, and also an engineering staff of over 500 which translates into definitive plant designs the techniques evolved by the research and development groups.

The hundredfold expansion in our research staff that has taken place over the past 27 years has been a gradual one to meet the need for a more intensive technical effort. It became apparent that the company's survival in a highly competitive industry depended upon a sound, comprehensive research and development programme, this quite apart from the fact that substantial financial returns also resulted from our technical effort.

A question which naturally arises in connexion with research and development concerns the financial return realized by the investors in those companies which have continuously expanded their research effort. This question is difficult to answer because returns on research are generally not realized until a considerable period of time has elapsed. But if research is carried out intelligently and methodically over a sufficient period, it is possible to compute the return in the form of profits to the company and its stockholders.

I cannot cite figures for the entire oil industry because most companies do not make them available, but I can reveal data prepared a short time ago on the research and development work carried out over a period of 10 years by my own company. The research appraised dealt primarily with manufacturing and processing, and the return on the money spent was considered, first, as savings in royalty payments that would otherwise have gone to outside research and development groups; second, as savings in manufacturing costs through the improvement of existing processes and products; and third, as added profits realized from new product development. The manufacturing and marketing groups of our company naturally made substantial contributions, particularly in the latter two categories, so that the savings and profits are by no means due solely to research and development. But in all cases the effort probably would not have been initiated except through research and development.

The savings in royalties which otherwise would have been paid to outside groups amounted to £3700 for each thousand pounds spent on research and development; profits realized through improvements in existing processes and products were £9600; profits from new products were £2100. This makes a total of £15,400 of added profit to the stockholders for each thousand pounds spent by the research and development groups. These results, I believe, demonstrate that in addition to public and national benefits, the 164,000 stockholders in our parent company have also received an excellent return from our research and development efforts. To me, research and development are not only a profitable feature of modern business but also an essential one. Without them I believe that any company or industry would stagnate, and over a period of time would lose a

major portion of its business to more far-sighted competitors.

Co-ordination to Production

Before research and development can benefit a particular industry and bring a reasonable return to shareholders, however, it is absolutely essential that laboratory results be properly co-ordinated into the overall pattern of production. Although this statement certainly appears obvious and may seem even fatuous to some of you, it has been my experience that it is fully appreciated only rarely, particularly by those whose careers are devoted to research and development. Too many of us tend to think of research and development as the principal factor involved in industrial progress. I am afraid that too often we are in the position of the double-bass player in the orchestra who thought that all the other instruments also were going *zum, zum, zum.* Actually, a number of factors are involved in bringing important new developments to the point where the public derives real benefit from them, and we, as members of research and development organizations, cannot well afford to ignore any of them. Industrial production is not like an arch in which research is the keystone bearing the central weight. It is like a chain made up of many links, and weakness in any link weakens the entire chain.

The first link is, of course, natural and human resources. Without this fundamental combination no success is possible. We saw in Germany a country with vast human resources but limited natural resources. Other countries present the opposite picture—abundant natural resources and only mediocre human resources to develop them.

The second link is specific discovery, invention, and research. By research I mean the experimentation undertaken to establish the facts in a given field which will show whether a proposed line of investigation seems to contain the seeds of a worthwhile development. This is the test-tube stage.

The third link is development—the laborious process of establishing the basic engineering information without which successful large-scale application of laboratory results is impossible. This is the pilot plant stage.

Fourth is the engineering application of development. Without sound, bold, imaginative engineering we would not be able to take the step from the pilot plant to efficient manufacturing plants capable of producing new or improved products at the low costs essential for the widest public benefit.

The fifth link in the chain is production management. No matter how well engineered and constructed an industrial plant may be, it cannot fulfil its vital function without production management skilled in overcoming the childhood diseases to which all new processes are subject, and in securing long-term, low-cost, maximum output from facilities. Production management also performs the vital function of moulding a contented labour force truly willing to work and truly desirous of contributing its maximum effort to greatest possible production.

Invention, engineering and production would all be of no avail without the sixth link—an effective sales and distribution group to put the products into the hands of the consuming public.

None of the previous elements I have mentioned could effectively fulfil their functions without courageous executive management quick to perceive the potentialities of new developments and, after careful appraisal of the risks involved, willing and able to support developments and improvements that show real promise.

The two final links in the industrial chain arise in the larger field of the nation as a whole. The first of these concerns the economic climate. Like the natural climate, it can be invigorating

and conducive to thriving growth, or it can be stultifying and depressive. We know that the whole process of industrial production from invention and research right through final distribution thrives best in a sound, freely competitive economic climate in which incentives and rewards encourage men to do their best.

The Political Climate

The final element I wish to call to your attention is one too seldom thought of in connexion with successful industrial enterprise. This is a sound political climate. It is here that the sense of security is born which gives people confidence to assume the risks involved in any important new adventure. Without this vital requirement, executive management certainly would be in no position to make recommendations to investors, and investors surely would not put money into new enterprises. The connexion between the political climate and successful industrial development is amazingly close. The alarming examples during recent years of the manner in which political instability and adventuring in various countries brought the industrial structure toppling down or interferred seriously with reconversion should give those of us who work in industry and those in political positions who are guiding the economic recovery of their countries case histories for the most serious study.

The factors I have mentioned—natural and human resources, invention and research, development, engineering application, production management, labour, effective distribution, executive management, economic climate, and political climate—are vital links in the chain of successful industrial production. Each is essential if a nation is to benefit from technical advances. The interlinking of these factors must be firm if the ultimate objective is to be achieved, if the peoples of the world are to obtain more of the things they need to satisfy their wants.

I am not prepared to deny that equal results could be achieved under some political and economic system other than a freely competitive democracy, but I do not think this has happened yet and I question seriously that it will happen. We have indeed been fortunate in both our countries for the last 50 years in having a system embodying all the elements which I have just mentioned. Even in periods of economic stress the chain has held together because scientists, industrialists, economists, and government leaders alike have felt that our system is sound and good. All alike have eschewed political experimentation and innovation as violent as those to which other countries have resorted with almost unfailingly disastrous results. Future progress in a nation dependent to the degree that both of ours are upon industrial development and production will be determined by whether the factors which form the links in the industrial chain are strengthened or weakened.

Research Philosophy

Turning now to some of the problems and considerations which devolve upon those charged with responsibility for formulating and carrying out research and development programmes, I should like to review a few of what might be called tenets of research and development philosophy which my associates and I, in 20 years of industrial research experience, have worked out for ourselves.

Research results cannot be measured by the number of people employed in the research and development department or by the number of pounds spent each year. I am sure all of us are acquainted with research groups, some of them very large, which, although they have been in existence for years, seem

to lack effectiveness. I have often been interested in trying to gauge the reasons why some groups appear to contribute more than others per unit of energy expended. In trying to make such an assessment, I find myself coming back to the matter of personalities involved. Research is not a commodity that can be plucked off a warehouse shelf. It involves the efforts of individuals constituting the research team, and success is in direct proportion to the intensity of the mental sparks emanating from each team member. What, then, causes such sparks to be generated?

One of the most important factors is knowledge of the problems to be solved. To assist effectively in the solution of a research or development problem, everyone participating must know the problems which exist and recognize their relative importance.

How, except in very rare instances, can a research and development team be expected to solve a problem unless it knows what the problem is in its entirety? How can the engineering organization design the best possible plant unless the organization has the full background of all research and development results? How can the production groups utilize their facilities effectively unless they are kept fully posted, not only on developments of possible immediate application, but also on laboratory results with possible future applications? How can management make sound decisions and be in a position to plan intelligently for the future without knowing what is cooking in the research and development kettles?

Information about a project to which the research organization is expected to apply its skills and time must flow freely—horizontally from one function to another and vertically from top to bottom and from bottom to top. Direct contacts throughout the organization are necessary through frequent meetings of technical, manufacturing and sales groups, and through plant and field visits. The manufacturing and sales groups must make just as serious efforts to call pressing problems to the attention of research and development groups as the research and development groups do to get their important results before the manufacturing and sales units for consideration. In my own organization we believe it absolutely necessary that those who direct research and development work, those who conduct it, and those who direct and carry out engineering, manufacturing, and sales have as broad and as up-to-date a picture as possible of the entire project and of the manner in which it will be handled. Continuing contacts are fostered at each operating level from top to bottom, and the interlacing of the information gained has proved to be of major importance. Apart from the incentive such a system provides, it also results in certain practical advantages. It enables a research man, for example, to apply promptly to his project new developments just uncovered by other research units.

This essential free flow of information cannot be realized if the production and sales groups look upon the research and development staff members as long-haired visionaries unable to perceive the importance of practical problems. Nor can it be brought about if the research and development team suspects the production and sales departments of lacking in imagination, of unreceptiveness to sound new ideas, and of being likely to claim full credit for developments put into successful large-scale application. Where there is such segregation of research and development on the one hand and manufacturing and sales on the other, it becomes necessary for the former group to sell its ideas to the latter. If, however, co-operation and understanding can be achieved, this necessity generally disappears. Misconceptions concerning the personal and mental attributes of one's associates in an industrial enterprise are best

dispelled through personal contacts. Insulation of the research and development department must be avoided at all costs.

Generation of Ideas

Even though the existence of the problems demanding solution may be recognized and fully understood, no research and development effort worth its salt can be conducted unless the research and development personnel have intelligent, ingenious ideas on how to solve the problems. This calls for the utilization of every possible device to stimulate the generation of ideas. In my own company we have put into effect many features of organization and administration primarily because we believe that application of these features would result in more and better ideas. We have found in our organization that one of the most effective methods of idea generation in the research and development field is the maintenance of close technical contact by research, development, and directorial groups with the work being carried out in other company units and also in the outside world. We hold numerous technical and progress meetings of our own, attended by representatives of each of the research, development, operating and sales units of our entire company. We arrange frequent visits to our operating plants for our research and development personnel, and we insist on frequent field contacts between our scientists and the major users of our company's products. We maintain close relations with the technical organizations of companies in industries allied closely to our own. Our men may be seen at practically all technical society meetings which bear upon the necessities of our industry.

We feel, too, as do many other research and development groups, that one of the easiest ways to spur the generation of ideas is to encourage our personnel to have a broad knowledge not only of the technical phases of our own industry, but of other apparently unrelated fields of technical development as well. I am sure that all of you have seen, as I have so many times, an important technical problem successfully solved by the application of advances previously made in another field. It is partly for this reason that we make plentiful use of consultants whose principal experience has been outside our own industry.

For many years our principal consultants have been university people of very broad background in a number of different fields both related and unrelated to the petroleum industry. It has been our practice to acquaint these men with practically the entire range of our company activities and to secure their suggestions and counsel in all phases of our research and development programme. In many cases we have also utilized the consulting services of university professors whose principal interests were in more restricted fields, for example, in agriculture, and during recent years in our consideration of the possibilities of industrial applications of atomic fission. Our use of free-lance consultants has been and still is quite limited.

The payments which we make to outside consultants amount to a little more than two per cent of the total salaries of our technical and professional staff. We are also accustomed to enter into research agreements with universities, sometimes on very broad lines and sometimes on specific problems of immediate importance. Our expenditures for such research grants to universities usually amount to slightly over three per cent of the total salaries of our technical and professional staff.

Through our consulting arrangements with staff members of universities and technological institutions, and through attendance by our own personnel at meetings of technical societies, we

attempt to stay in very close touch with research programmes being carried out in the principal academic centres. Our contacts with governmental research normally result from presentation at technical society meetings of the results of such research by various governmental officials. At Government invitation, members of our staff often act in an advisory capacity to governmental research agencies.

Stimulation of Ideas

Competition is unquestionably one of the greatest stimulators of ideas. A primary source of competitive stimulation is current knowledge of the characteristics of a competitor's products, particularly his new ones. Nothing that I know of spurs a research and development team to greater endeavour than to have a competitor appear with a product involving some important new improvement. In the field of process development such external competition is more difficult to achieve, since, because of the time required for engineering, manufacturing and sales, the process work on which a competitor is engaged frequently does not become known until several years after its completion.

In my company we have, therefore, adopted the practice of stimulating competition between our own research and development units. Frequently we practise duplication, more theoretical than real, between individual laboratories, not only because the approach to a given problem in different laboratories varies, but also because we have found it possible to secure a real competitive urge through assigning to different units different phases of a given project. A number of years ago we felt that several of our important projects were suffering because the entire responsibility had been assigned to just one group. By some strategic reassignment of projects, we created a competitive situation in which it was possible to call a laboratory manager's attention to progress being made by another hard-working group or to remind a team, perhaps in New Jersey, that another team in Louisiana was close on its heels or had even leapfrogged it.

This practice has never in any way been permitted to interfere with the free and complete flow of all information from unit to unit, nor, I might add, have we, except in a few cases where work is assigned to us by government agencies and certain security barriers were required of us, placed any particular project under secrecy wraps as far as our own organization was concerned. Our men are carefully chosen. We know that they are entirely trustworthy, and they have never let us down.

Individual Responsibility

Although any problem of organization must take into account the characteristics and capabilities of the individuals available, this is true to an unusual degree in organizations conducting research and development. In my own company we have found it completely unsound to draw up a rigid organization chart and have frequently shifted the size of our groups and the responsibilities assigned to them so that full advantage could be taken of the capacities of the individual. We have, moreover, made it a practice to push responsibility for research and development results down the line, even to the point of overloading, in order that every man in the group, from laboratory director through group heads and section heads to individual researchers, would share in the responsibility for the project. Our aim is to instil into each member of the organization a sense of individual responsibility sufficiently deeply rooted to call forth his maximum ingenuity and initiative.

We encourage each of our research workers to devote about ten per cent of his time to work on original ideas. He is not required to account in any way for this time. We felt that this step was desirable in order to give a man who has conceived an idea an opportunity to carry it far enough forward to determine whether it is worth while.

We also try to take into careful consideration the individual's appetite, or lack of appetite, for directorial responsibility. Some men relish directorial loads, while others do their best work when they carry no appreciable responsibility other than for their own individual efforts. Our entire staff understands that it is the contribution which counts, and that the "lone wolfer" may be just as valuable and may receive just as much pay as the members of his department who like to and do carry a load of directorial responsibility.

No less important than encouraging the generation of ideas is the avoiding of practices which tend to discourage ideas. Any sudden and drastic shrinkage in technical personnel, for example, will result in losses of morale and effectiveness out of all proportion to the saving thereby achieved. To do his best work, a scientist or technician employed in research and development work must have the assurance that top management is sympathetic to research and development, understands the necessity for maintaining an adequate programme, and is appreciative of the results achieved.

Most of us in industrial research and development are kept adequately impressed by top management with the fact that our efforts must result in over-all financial returns. The research and development groups themselves fully appreciate the bread-and-butter aspects of commercial application. But I think I speak for the group as a whole in saying that the personal gratification that comes from seeing one's work reach the brick-and-steel stage and of knowing that its results in the form of useful products are finally coming into the hands of the public is equal in every way to the executives' justifiable desire to see the money invested in research and development pay a financial return. Most top-flight research and development men would not, I am sure, be willing to stay in an organization where application of their work failed to materialize in any important respect.

The Research Budget

Normally about three-fourths of a research and development budget is made up of salaries and directly related items, materials amount to another 12 or 15 per cent, and depreciation, rent, travel and general expenses account for most of the rest. It is, therefore, clear that the size of a research and development budget is fixed by the approved number of personnel involved in the programme. Once the total number of personnel has been determined, the total expenditures are pretty well established. Therefore, top management, after a review of the general fields of endeavour in which its research and development department is involved, devotes its chief consideration to the number of people engaged in the programme. Once the size of the organization is fixed, the expenditures on various projects have to depend pretty much on the degree of emphasis put on these projects as human endeavour is allocated.

In my own company we make up a project budget each year by first fixing the total number of people to be utilized and then risking a guess as to how their efforts are to be divided among our major fields of effort. But the division by projects is only a guess and top management clearly recognizes it as such. Never since I have been connected with the company has the budget on

any given major project come within gunshot of the actual expenditures as they were totalled up at the end of the year. Had this situation ever materialized, I strongly suspect that those of us responsible for research and development results would have long since been sacked because of our inability to recognize when shifts in emphasis were needed. Within the research and development departments we review the state of our projects almost continuously, dropping the dead ones and encouraging others as day-by-day results and ultimate economic prospects seem to warrant.

Manpower Problems

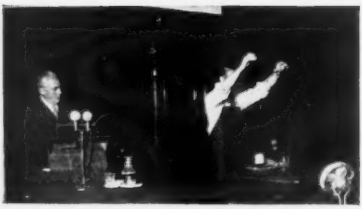
Before concluding, let me touch briefly upon a matter that I consider of burning importance to all of us who work in the field of technological research and development. Every one of us here knows that for the next several years we must meet our peacetime research and development requirements with far fewer trained personnel than we need. Our technical manpower must be stretched to the utmost until such time as our universities and technical institutions once more provide us with an adequate number of well-trained men and women, and until we are able to build new facilities in which to house them. Not only must we endeavour with depleted staffs to meet our own pressing problems, but, in my opinion, a way must somehow be found to take care of at least some of the requirements of countries friendly to our two nations. Many of our technological skills in industry and agriculture, if extended to other nations, could do much to raise quickly their standards of living. Extension of credits and even shipments of materials and equipment will not serve the fullest purpose unless they are implemented with the technological guidance needed for efficient utilization.

By giving such assistance, we could prove to all the world that our system of democratic competitive enterprise not only works but that it can contribute more to the well-being of people than any other system thus far devised. Our own national interests should provide us with all the incentives required to enlist our help. I recently returned from an extended visit to some of my country's southern neighbours, and my observations convinced me of two things: these people and many others in countries throughout the world are eager for a way of living that they cannot now provide through their own skills, and if they do not receive assistance from countries such as ours, they will turn to inferior substitutes with probable accompanying political developments unfavourable to us. This situation does not exist solely with respect to Latin America. You in the United Kingdom have closely paralleled problems with which to deal. I am sure you will agree with me that these are matters that will not bear long delay.

In conclusion, I should like to say that I am very happy to have had this opportunity to talk to you about research in our industry. Great as the advances have been in the past, they must be even greater in the future if we, as free people, are to meet our responsibilities. In order to help build a world of peace, we must not only guard against deterioration of the high standards of technical achievement set during the war, but we must advance the effectiveness of our research, development and engineering even beyond the present high level. Given a free and truly competitive system in which to work, I have no doubt that our scientific groups will deal successfully with the many problems the future will unquestionably bring.

THE CADMAN MEMORIAL LECTURE AS VIEWED FROM THE AUDITORIUM

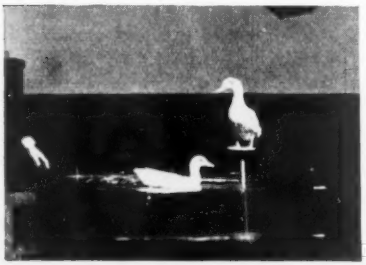
A section of the large and appreciative audience which gathered at The Royal Institution on June 4 to hear Robert Price Russell deliver the second Cadman Memorial Lecture of the Institute of Petroleum



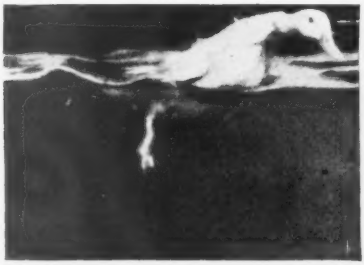
Dr Hardy demonstrated the manufacture of Butyl rubber from isobutylene and a small amount of a diolefin. Below he is seen polymerizing the mixture with boron fluoride as catalyst and—

(above) *he demonstrates that heated Butyl rubber is almost as lively as natural rubber but that at room temperature the synthetic product has practically no bounce*

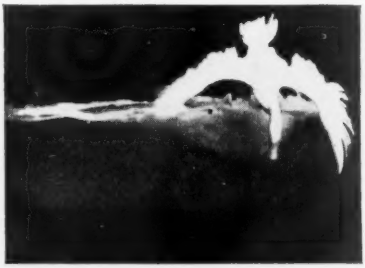
"You have all heard that water runs off a duck's back. That isn't always necessarily true. A duck floats because of the air entrapped in its feathers. Make the water wetter with a petroleum wetting-agent—a polyolef in toluene sulphanate—and——"



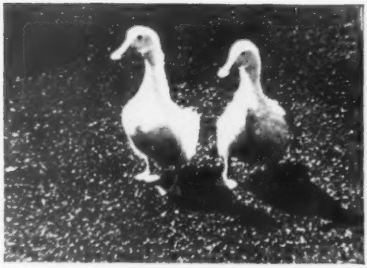
Come along in, Donald, this is a grand drop of water!



Hi, what's wrong with this? Have I been torpedoed or is this wetter water?



I must make an effort to get out of this before I am in it too deeply



Oh, that's better. No more water for us—not even in the right spirit

Stills from the film taken by and projected by Johnnie Hall

Dr Hardy completes the manufacture of Buna-S rubber by adding the acid, after which he showed that his product bounced just as well as natural rubber

The meeting concluded with the presentation of the Cadman Medal to Robert Price Russell (left). Medals were also presented to (left below), Lord Cadman (on behalf of Lily Lady Cadman) and (right below), to Sir William Fraser, for transmission to Abadan

SCOTTISH TRIBUTE TO SIR THOMAS HOLLAND

At the meeting of the Scottish Branch on June 2, 1947, the Chairman, Mr. Robert Crichton, referred to the death of Sir Thomas Holland. Summarizing the career of Sir Thomas, he said that many honours had been showered upon him from all over the world, and what better tribute could a man have. He had given the benefit of his knowledge and training to his fellow men and a great man had passed away leaving behind him a name that would long be remembered.

The audience stood in silence in memory of Sir Thomas.

PERSONAL NOTES

THE Institute offers its congratulations to its Fellow, Professor *R. J. Forbes*, formerly with the Royal Dutch Petroleum Company and its subsidiaries, on his recent appointment to the Allard Pierson Chair of History of Natural Sciences and Technology in the University of Amsterdam.

Dr A. E. Dunstan, Hon.F.Inst.Pet., has been appointed by the British National Committee for Chemistry of the Royal Society as one of the British delegates to the General Assembly of the International Union of Chemistry. He is also a representative of the committee at the XIth International Congress of Pure and Applied Chemistry.

Included in H.M. The King's Birthday Honours were the following personnel of the petroleum industry: *Leslie William Farrow* (C.B.E.), chairman of C. C. Wakefield & Co., Ltd., and a director of Trinidad Leaseholds Ltd.; *Herbert Henry Kinloch* (O.B.E.), manager of Shell Petroleum Co., Ltd., Salisbury, Southern Rhodesia; *John Lamb* (O.B.E.), technical manager, Anglo-Saxon Petroleum Co., Ltd.; *Frederick William Rant* (O.B.E.), manager, Anglo-Iranian Oil Co., Ltd., Aden Protectorate; *William Meadows* (B.E.M.), driller, Anglo-Iranian Oil Co., Ltd; *John Fulton Robinson* (B.E.M.), rigger, Anglo-Iranian Oil Co., Ltd.

E. LeQ. Herbert, B.Sc., F.Inst.Pet., has been appointed honorary secretary of the Chemical Engineering Group of the Society of Chemical Industry.

H. le M. Stevens-Guille, M.Inst.Pet., is now engineering co-ordinator for the production department of Imperial Oil Ltd., and its subsidiaries in Western Canada.

C. W. J. Biddolph, M.Inst.Pet., is shortly leaving England to take up a business appointment in India.

B. G. Banks, F.Inst.Pet., for 24 years refinery manager in Trinidad to Trinidad Leasehold, Ltd., has recently returned to England and is now in the company's technical department at its London headquarters.

Major P. R. Clark, F.Inst.Pet., R.A.O.C., was a welcome visitor in the office recently. He has spent the last few years with the army in various parts of the Middle East and expects shortly to be visiting the Far East.

D. Clayton, D.Sc., M.I.Mech.E., F.Inst.Pet., has resigned his post as officer-in-charge of the Joint Ministry of Supply and Admiralty Advisory Service on Lubrication to join the Technical Department of Imperial Chemical Industries Limited, where he will be responsible for an advisory service on lubrication and allied problems.

Dr George S. Hume, O.B.E., has recently been appointed Chief of the Bureau of Geology and Topography, Canadian Mines and Geology Branch. He joined the Canadian Geological Survey in 1921 and made the petroleum and natural gas resources of Canada his special study. From 1941 to 1945 he was loaned to the office of the Oil Controller, Department of Munitions and Supplies, and for his services was awarded an O.B.E. in the King's Dominion Day Honours List of 1946.

Dr F. H. Lahee, who has recently been appointed research counsellor of the production department of the Sun Oil Co., has been associated with the company since 1918 and has been its chief geologist for 27 years. Previously he was an instructor and assistant professor at the Massachusetts Institute of Technology.

Dr G. G. Oberfell, recently received the honorary doctor of science degree from the University of Tulsa in recognition of his contributions in the field of petroleum research. He is vice-president in charge of research and development and a director of Phillips Petroleum Co.

PLASTICS AND RESINS FROM PETROLEUM*

By ROBERT PRICE RUSSELL

THE production and utilization of plastic materials is rapidly taking on the aspect of a major industry, both in Britain and the United States. During the past 10 years output of plastics increased over 600 per cent in the United States, and a similar trend has prevailed in the United Kingdom.

Much of this expansion was due to war demands for plastics. Plastics were used in planes; the De Havilland Mosquito is an example of extensive adaptation of plastics for the plywood used in aviation. Plastics were used on ships in countless ways, and in equipment for the ground forces they were used all the way from buttons to bullets.

But the war cannot be given all the credit for the increased use of plastics. Ever since their beginning plastics have had great popular appeal, and

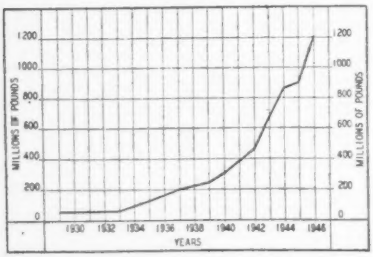


Fig. 1.—Synthetic resin production in the U.S.A.

public enthusiasm has been a major factor behind their growth. Ever since the days of the celluloid collar, people have been interested in plastic developments—unbreakable chinaware, bright coloured ornaments, cellophane wrappings, nylon stockings, rayon and countless other applications.

Fig. 1 gives a quick over-all picture of United States production of plastics. It is believed that the use of plastics in everyday appliances has had a similar development in the United Kingdom, so that in the American development of this industry can be seen a fairly accurate counterpart of your own development.

These figures are exclusive of both rayon and synthetic rubber. Although both of these products are closely related to the materials referred to as plastics, it is not usual to classify them as such in the United States. Were they to be included, the increase by tonnage and probably by percentage would be much greater.

What is referred to as plastics is covered by the group shown in Fig. 2, which also reveals the relative importance of each, on the basis of production in the United States. The category "all others" deserves some explanation. Some of the materials included in it may rise to far greater prominence

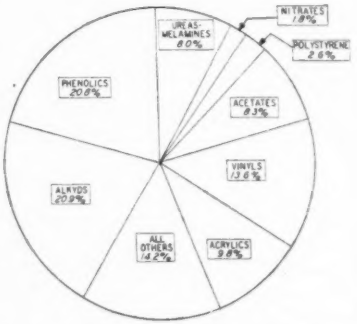


Fig. 2.—Distribution of synthetic resins by type in the U.S.A.

* An extra-mural lecture of the University of Birmingham held jointly with the Midlands Section of the Institute of the Plastics Industry and the Midland Chemists Committee on June 10, at the University, Edmund Street, Birmingham.

from the standpoint of relative tonnage than they enjoy to-day. In this group, among others, are polyethylene, nylon, other polyamides, ethyl cellulose, maleic resins, silicones, and resins synthesized from petroleum hydrocarbons.

Perhaps because of the recent rise in the application of plastics in industry, science and daily living, they are thought of as materials of comparatively recent origin. Many, indeed, are products of the past few years. On the other hand, old records show that such modern-sounding substances as vinyls and polystyrene were known a hundred years ago as laboratory curiosities. Organic research probably produced numerous others whose potentialities and utilities were not recognized. Realization of commercial possibilities lagged, even after cellulose nitrate made its first appearance as a plastic in 1870 and after the discovery of casein plastics in 1890 and the advent of phenol formaldehyde condensation products in 1909.

These were landmarks, as can be seen in retrospect, but it was not until World War I that extensive development of plastics got under way and an industry of importance began its rise. Then in the late twenties came alkyd resins with the promise of revolutionizing the protective-coating industry. Soon after came cellulose acetate and the widening application of phenolics. The next decade saw the introduction of urea resins, the acrylates, and the vinyls. Polyethylene, polyvinylidene chloride and the silicones were, in time at least, developments of the war.

World War II, of course, opened up scores of new avenues of plastic uses: in the air, on the ground and underseas. Indeed, as made-to-order materials were created to meet special requirements, plastics made some of our most important war efforts possible. Their contribution in the development of radar and various sonic and electronic devices, the scores of instruments utilized in communications, navigation, range finding and combat weapons needs no emphasis here. Their field of usefulness defies enumeration but some idea of the scope and adaptability to various physical requirements can be shown graphically, as in Fig. 3.

To-day, the extensive manufacturing facilities installed to produce wartime plastics are turning out plastics for peacetime uses. Sales in the United

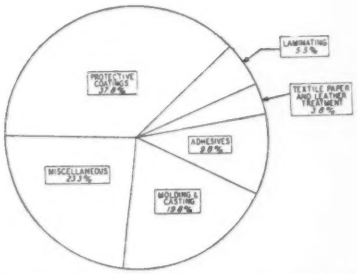


Fig. 3.—Uses of synthetic resins in the U.S.A.

States are expected soon to reach a thousand million dollars per year. The only limitation on the use and application of plastics in either Great Britain or the United States seems to be the supply of raw materials, which currently is far from plentiful.

As for the future, the ability of the polymer chemist to make plastics better, and, at the same time, to make them less costly, more attractive, more resistant, and lighter is apparently the ultimate goal to be achieved. Often the development of new products requires raw materials that have not yet reached commercial realization. This point can well be illustrated by synthetic rubber's large needs of butadiene and nylon's requirement of adipic acid, both of which not so long ago were only laboratory curiosities.

In order to take care of its present requirements, and allow for expansion and the commercial development of new products, the plastics industry must be assured of a large and continuous supply of raw materials. In looking for such possible supplies, it is natural to think of three large natural reservoirs of basic raw materials available, i.e., coal, cellulose and petroleum. To complement this group: water, air, salt and sand might be added to permit most of the additional raw materials necessary for various permutations and combinations of different polymer molecules.

Referring to Fig. 2 it should be noted that phenolics, alkyds, and cellulosics, which are generally associated with coal and cellulose derivatives, still command the largest share of the resin market. It is believed that this factor is due mainly to their early development, the abundance of raw materials formerly available, their relatively low price and the large number of producers engaged in making them. For many years, it has been customary to classify synthetic resins as those derived from coal tar and non-coal tar sources. It is, perhaps, inadvisable to draw too close a distinction between these sources because at present, and more so in the future, raw materials required for the so-called coal-tar resins will be derived, at least in part, from petroleum rather than coal. Due to the fact that petroleum has recently given indications that it can rival coal tar as a potential producer of aromatics, much of the future raw materials for even the phenolics and alkyds will be traced to petroleum origin. In contrast, a complete overlapping of substitution of alternate raw materials for the cellulosics is not so apparent. While it is true that many of the raw materials that may be used in modifying cellulose can wholly, or in part, find their origin in petroleum and coal, basically these resins stand out as a definite specific class.

The petroleum industry has two definite interests in the plastics field. One is as a potential supplier of basic raw materials required for existing or possible new plastics, while the other is as a producer of finished hydrocarbon resins.

With the development of improved refining techniques, such as fractionation, reforming, polymerization, hydrogenation, hydroforming, catalytic cracking, alkylation and isomerization, large quantities of potential raw materials for plastics—in the form of such pure hydrocarbons as ethylene, propylene, butylenes, butadiene, isoprene, *cyclo*-pentadiene, toluene, xylene, and many others—have been made available. An idea of the quantities of by-products that may be realized from modern refining operations is illustrated by the 450,000 tons of butadiene per year produced during the latter war days for synthetic rubber. It may be of interest that this quantity of butadiene expressed in terms of crude oil represents only about 0·8 per cent of the yearly United States production.

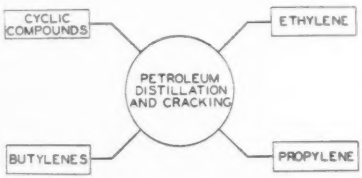


Fig. 4.—Plastic raw materials from petroleum

In order to obtain a preliminary idea of how the petroleum manufacturers might qualify as potential suppliers of raw materials for the plastics industry, some of the simpler olefins and cyclic compounds that are already available in large quantities and in a high state of purity may be considered. These compounds are ethylene, propylene, and butylenes, aromatics, and other cyclic compounds (Fig. 4). From these raw materials used as building blocks,

a whole series of plastics can be derived.

The simplest and probably the largest type is the so-called ethenoid plastics, which are characterized by the vinyl grouping $CH_2=C-$, and are direct derivatives of ethylene (Fig. 5). Ethylene can be made readily available from gas oil and propane cracking.

First there is the only direct derivative of ethylene, polyethylene, a thermoplastic resin composed of long chains of

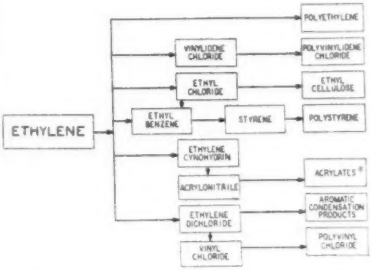


Fig. 5.—Plastics derived from ethylene

methylene groups linked together by polymerization at relative high temperatures and pressures. The early work carried out by Fawcett and Gibson in 1934 was largely responsible for the development of these new polymers. Commercial production of polyethylene was realized shortly thereafter in Great Britain under the trade name "Alkathene" as well as under the genetic name polythene. Considerable expansion occurred during the war both in Britain and America when the material was found to have extensive war use in the high-frequency electrical field. The desirable properties of polyethylene suggest many peacetime requirements which will undoubtedly require additional production facilities.

Another group of ethenoid thermoplastics which has shown considerable expansion is the vinyl resins produced from vinyl chloride which may be derived by the direct chlorination of ethylene. As a group, the polyvinyls cover the entire thermoplastic field from hard-molding resins to tough, flexible products. Their versatility of application, developed during the war and to a greater degree in the post-war period, makes them almost an all-purpose product.

Similar types of resins can be derived from unsymmetrical dichloro-ethylene which has for its basic raw materials petroleum and brine. Ethylene from the former and chlorine from the latter react to form the monomeric vinylidene chloride ($CH_2=CCl_2$) which can be polymerized and co-polymerized to produce polyvinylidene chloride resins ranging from flexible to hard, tough, and thermoplastic properties. Although known for over a hundred years, their commercial development was not realized until "Saran" was introduced to the plastics trade by Dow in 1939 for use in mono-filament fibres. Since that time, it has found extensive uses for surface coatings, extruded tubes and rods, electrical insulation and self-supported films. Since the commercial exploitation of the vinyls, numerous copolymeric resins of vinyl chloride and vinylidene chloride with other vinyl derivatives have appeared, and they should also be considered to be derivatives of ethylene.

Polystyrene, a plastic with excellent moisture and chemical resistance, as well as good insulating properties, is a polymer of styrene or vinyl benzene which uses ethylene and benzene as basic raw materials. As early as 1911, the first recorded patent disclosing the use of polymerized styrene as an electrical insulating medium was issued to Dr Matthews of London. Polystyrene resins were the first manufactured in the United States in 1937—more than a century after the resin was first

prepared in Great Britain. Enormous quantities of monomeric styrene were available during the war years, and considerable expansion of polystyrene production is expected in the United States and other countries.

The acrylates are polymers of either acrylic or methacrylic esters. They range from soft, tacky, semi-liquids to hard, tough, thermoplastics characterized by their crystal clarity and remarkable optical properties. The acrylates can trace their origin to ethylene indirectly through the intermediates of ethylene cyanohydrin and acrylonitrile. Acrylonitrile is also an intermediate of one of the oil-resistant synthetic rubbers.

Another interesting plastic product, although not truly an ethenoid resin, but nevertheless a direct derivative of ethylene, is ethyl cellulose. Ethyl chloride, required for alkylation of cellulose, is produced in large quantities from ethylene or ethyl alcohol, both of which may be directly produced from petroleum. Ethyl cellulose has found extensive uses in flexible lacquers, adhesives, low-temperature insulators and self-supported films.

Other ethylene derivatives fall in the class of products obtained from ethylene dichloride by the condensation of aromatics to produce long chain linear polymers. The same ethylene intermediate has also been used in producing products of the "Thiokol" type, which probably should be classified as a modified type of synthetic rubber rather than a plastic.

Propylene is one of the most plentiful of the hydrocarbon olefin gases, but it does not seem to be quite as versatile a plastic raw material as ethylene. This may be due primarily to the early exploitation of ethylene derivatives rather than the nature of propylene itself. This field awaits further development, since progress was curtailed considerably during the war. Nevertheless, the oxygenated derivatives of propylene are finding a definite place in many of the various plastics. Probably the most commonly used derivative of propylene in plastics is acetone. Large quantities of acetic anhydride and acetic acid employed in cellulose acetate production are produced indirectly from acetone made by the dehydrogenation of *iso*propyl alcohol. Some of the available acetone is used as an intermediate in the production of methacrylate plastics. Even before the war, these products found extensive use in illuminated signs and displays, dentures, and even the decorative fields. During the war they were required for bomber astrodomes and cockpit coverings where their light weight, good optical properties, processability, shatter-proof properties and weather resistance made them invaluable.

The alkyd resins are used extensively for coatings and finishes, these constituting one of the major uses of plastics products. It is interesting to note that the alkyd resins in one form or another account for better than half of the total requirements for protective coatings. One of the common intermediates for production of these resins is glycerol, which is normally a by-product of the soap industry. By the direct substitutive chlorination of propylene through the intermediate allyl chloride, synthetic glycerol can be

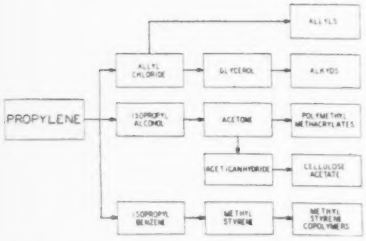


Fig. 6.—Plastics derived from propylene

produced. Recently, this process has reached commercial possibilities and steps are being taken by Shell Chemical Company to make synthetic glycerol available in large quantities.

Quite recently, new resins known as the allyls have been commercially introduced. These are derived from allyl alcohol which is obtained upon hydrolysis of allyl chloride. The latter can be produced by the chlorination of propylene. Reaction of allyl alcohol with di-basic acids with or without other compounds such as glycol and styrene yield an allyl ester monomer having properties of a thermoplastic resin monomer which can further undergo polymerization to give products similar to the usual commercial thermosetting resins.

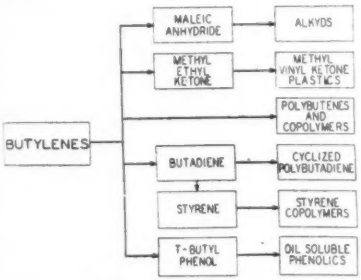


Fig. 7.—Plastics derived from butylenes

Methyl styrene, which is synthesized by the dehydrogenation of *iso*propyl benzene, completes the types of resins that might be derived from propylene. Considerable development work has been done on methyl styrene polymers and copolymers, many of which have quite interesting properties but as yet do not have widespread commercial value.

In the past, the utilization of butylene derivatives for synthetic rubber has been considerably greater than for plastics (Fig. 7). Large quantities of butylenes recently made available for the production of butadiene surely should stimulate research in this direction.

Polymers of butylene, produced by Butlerov as early as 1873, were probably one of the first derivatives of butylene. Commercial development of high molecular weight polymers of *iso*butylene was carried out in Germany. Due to the availability of raw materials and the discovery that these high molecular weight polymers form valuable addition agents for lubricating oils, my company became interested, about 1936, in the commercial production of these polymers in the United States. The polybutylenes or polybutenes resemble rubber in many physical properties, but they differ chemically in that they are entirely saturated. Although many industrial uses for polybutene have been developed, its extensive use in plastics has been somewhat limited because of its inherent rubbery nature, cold flow and poor processability. Recently, considerable development work has been done in modifying polybutene to improve many of its inherent shortcomings as a plastic material.

Most of the remaining resins are more or less in the development stage, with the possible exception of the oil-soluble phenolics and high styrene butadiene copolymers which have found commercial applications recently as surface coatings and adhesives. Although oxidation of butylenes to maleic anhydride has been carried out on a semi-commercial scale, benzene still remains the large potential source for maleic anhydride. Recently, cyclized polybutadienes and styrene copolymer resins have found applications similar to those in which cyclized rubber was formerly used.

Clear, tough thermoplastic resins similar to the methacrylates may be prepared from methyl vinyl ketone monomers which are derivatives of methyl ethyl ketone. Although these

products are of interest, further developments are required before they become of prime importance.

The petroleum industry, as a result of improvement in cracking and refining operations, has become an important producer of aromatic and other cyclic compounds. It seems logical that they may be a competitive source of raw materials (Fig. 8) for thermosetting resins of the phenolic and alkyd type. Toluene, whether obtained from coal tar or petroleum, has not been looked upon with favour as a plastic raw material for cresylic resins. Cresol directly obtained from coal tar by the synthesis from toluene usually contains mixtures of *ortho*, *meta*, and *para* isomers. *Meta*-cresol, the most preferable from the standpoint of producing a superior thermosetting resin, is by far

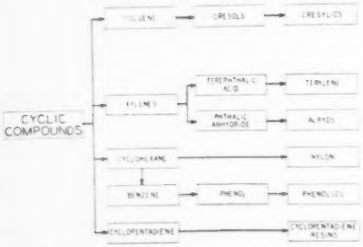


Fig. 8.—Plastics derived from cyclic compounds

the most difficult to obtain in a pure state either by synthesis or separation. What has just been said relative to cresol might be applied equally to the xylenols. The most desirable xylenol and, incidentally, the most difficult to obtain is 1, 3, 5-xylenol which has both the *ortho* and *para* positions available for linear polymerization and cross-linking.

There has been an increased interest, especially in the United States, and possibly somewhat magnified by the shortage of naphthalene, in the oxidation of petroleum-derived *ortho*-xylene to phthalic anhydride. Similarly, *para*-xylene can readily be oxidized to terephthalic acid. The fluid catalyst technique developed for petroleum cracking looks quite promising for the above-mentioned operations, due to the close temperature control which can be achieved, since this is important in this type of oxidation process. Commercial production of phthalic anhydride from *ortho*-xylene is already being carried out in the United States. No doubt terephthalic acid could be produced by a similar type of operation, whenever required in large quantities for your newly developed synthetic fibre.

Another interesting development has been the isolation of *cyclo*hexane from petroleum sources. *Cyclo*hexane may be converted either to benzene or used indirectly for the production of polyamides of the nylon type. In the near future, it is expected that increased quantities of benzene will be produced from the hydrocarbon streams, and this benzene can be converted directly to maleic anhydride by oxidation or to phenolic resins by condensation.

Before leaving cyclic compounds, a word might be said about *cyclo*pentadiene, which has been available in somewhat limited quantities from coal tar. Indications are that petroleum may become a major source of this interesting and highly reactive cyclic diolefin. Considerable development work is going forward in producing satisfactory *cyclo*pentadiene or modified *cyclo*pentadiene resins, some of which have already been made available commercially.

It has been indicated that the petroleum industry is a substantial supplier of basic raw materials for plastics manufacture and that it may become an even larger factor. There is also another and equally important phase to be considered: petroleum as a source of synthetic all-hydrocarbon resins.

The development of hydrocarbon polymers has been tediously slow. Early attempts to convert by-products of the petroleum industry into polymers usually resulted in products having poor physical properties as measured by plastic standards. Progress in improving these properties was not made until segregated fractions were utilized as starting material and improved polymerization methods were developed. Only during the past decade when large quantities of relatively pure olefins and diolefins became available has the commercial production of synthetic hydrocarbons such as polyethylene, poly*iso*-butylene, polystyrene, and polydiolefins been possible. In the past few years, many new trade names have appeared such as Styraloy, Pliolite-S, Darex and a host of others.

The possibility of modifying the properties of synthetic rubber to meet various needs of the industry stimulated exploratory work in the Esso Laboratories, and attempts were made to produce tailor-made hydrocarbon polymers. Basically, many of the hydrocarbon polymers have desirable characteristics such as good chemical resistance, excellent moisture-proofing qualities and superior electrical properties, but in many cases some have poor aging properties, especially those that are highly unsaturated.

Quite often, the so-called diolefin polymers are found to be over-functional, that is overly reactive, and they thereby pass through a stage of good physical properties prior to general deterioration. Our interest has been centred primarily in hydrocarbon polymers with functionality or reactivity controlled by structure and type of unsaturation. This concept rose quite naturally from the initial work of Butyl rubber, which represents a real departure from natural rubber in that the cross-linking or vulcanization is brought about through the functionality of the polymer rather than by selection of reaction conditions for cross-linking.

With this somewhat basic approach in mind, the problem of producing synthetic hydrocarbon polymers with various degrees of reactivity, and, in addition, having rubbery to resinous properties was encountered. Research has led to the development of both thermoplastic and heat-convertible hydrocarbon resins, of which stylene and A-resin may be cited as typical examples.

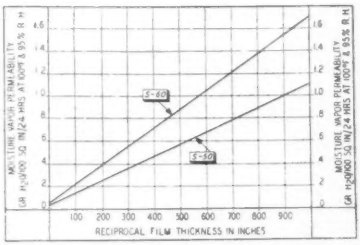

MOISTURE VAPOR PERMEABILITY
GR H2O/100 SQ IN/24 HRS AT 100°F & 95% R H
S-60
S-50
100 200 300 400 500 600 700 800 900
RECIPROCAL FILM THICKNESS IN INCHES

Fig. 9.—Moisture vapour transmission versus reciprocal thickness for stylene

Stylene combines many of the desirable properties of various polymers derived from single hydrocarbon monomers that cannot be obtained by merely blending individual polymers. Intermediate properties can be obtained by interpolymerization of two or more hydrocarbon monomers at different ratios and under varying conditions which gives unsuspected properties in many instances without requiring the use of organic plasticizers. Such variation of properties as hardness, plasticity, tensile strength, elongation, permanence, sunlight stability, processability and moisture vapour permeability are often a function of the polymerization conditions and ratios of reactants used. One of the outstanding properties of stylene—its low moisture vapour permeability—illustrates this point further.

In Fig. 9 is shown the effect of stylene composition (S-60 and S-50) on the moisture vapour permeability as the thickness of the films varies. Permeability is expressed in grams of water vapour that will diffuse through a film area of 100 square inches every 24 hours at 100°F and 95 per cent differential relative humidity. It is interesting to note that the results obtained follow quite closely Fick's law that the moisture vapour permeability of hydrophobic films varies inversely with the thickness. It is possible by determining optimum conditions to produce polymers of this series that will have a lower moisture vapour permeability than any currently produced plastic materials.

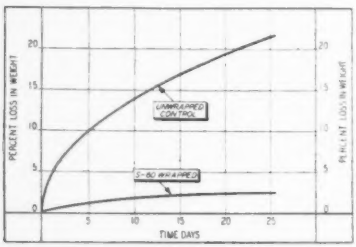


Fig. 10.—Stylene for packaging lemons. Film thickness 0.0005 in., stored over calcium chloride at 25–30°C.

In addition to the use of stylene for coating paper, either alone or in combination with waxes as a moisture barrier for the general packaging field, self-supported films should find widespread application in packaging fresh vegetables and fruits. Comparative data are shown in Fig. 10 on the percentage loss in weight between stylene wrapped and unwrapped lemons at different storage periods. These data show that, by employing such a packaging technique, it would be possible to extend the distribution period of many perishable food products, thereby benefiting both the producer and the consumer.

A-resin represents a series of all-hydrocarbon resins having thermosetting properties that are adaptable to the general surface-coating field. This type of polymer illustrates the properties that may be built into the molecule by carefully controlling functionality during polymerization. These resins are reactive with typical vegetable drying oils at relatively short oil lengths (15 to 18 gallons of oil/100 lb of resin) and under the usual varnish-making conditions. The reactivity, expressed as the time necessary for a thin film of the resin to gel or an oil-resin blend to reach a definite viscosity at a specific

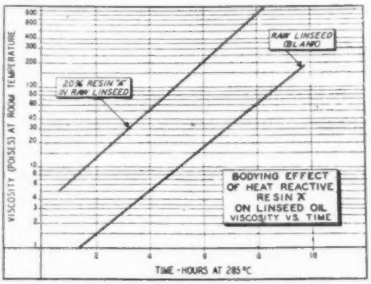

VISCOSITY (POISES) AT ROOM TEMPERATURE
RAW LINSEED (BLANK)
20% RESIN "A" IN RAW LINSEED
BODYING EFFECT OF HEAT REACTIVE RESIN X ON LINSEED OIL VISCOSITY VS. TIME
TIME - HOURS AT 285°C

Fig. 11.

temperature, is believed to be a function of the number of active methylene groups in the molecule. The heat-reactive properties of the resin account for the pronounced accelerating effect on the body of drying oils as shown in Fig. 11. As noted, the cooking or polymerization time of raw linseed oil is reduced to about 50 per cent by the addition of 20 per cent resin (50 gal length). More reactive resin types can be synthesized to decrease the cooking time by as much as 70 to 80 per cent before gelation takes place.

In the past, many of the varnish-type resins obtained from petroleum have not been accepted by the trade due to their poor colour, inferior chemical

resistances, and undesirable weathering characteristics.

To show what can be accomplished by controlled synthesis, it is interesting to compare the demerit rating assigned to the over-all chemical resistance (water, acid, grease, and soap) of 15-gallon linseed A-resin baked and air-dried films with films prepared from 20-gallon linseed oil-varnish resins having favourable acceptance (Fig. 12). With the exception of the 100 per cent phenolics, which are known to have outstanding chemical resistance, the A-resin finishes are closely competitive with the alkyds and somewhat superior to the others. Additional properties such as flexibility, adhesion, gloss, and weathering characteristics are also competitive. The latter may be well illustrated by Fig. 13 showing a 50-cycle weatherometer test of litho-red pigmented A-resin, alkyd and modified phenolic panels. However, more extensive outdoor tests are necessary to check our preliminary observations.

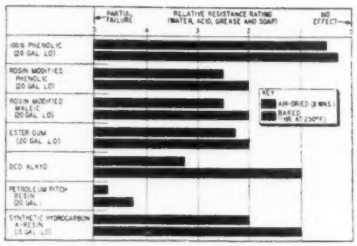

RELATIVE RESISTANCE RATING
(WATER, ACID, GREASE AND SOAP)
100% PHENOLIC (20 GAL. LO)
ROSIN MODIFIED PHENOLIC (20 GAL. LO)
ROSIN MODIFIED MALEIC (20 GAL. LO)
ESTER GUM (20 GAL. LO)
DCO ALKYD
PETROLEUM PITCH RESIN (20 GAL.)
SYNTHETIC HYDROCARBON A-RESIN (15 GAL. LO)
KEY
AIR-DRIED (8 HRS.)
BAKED (30 MIN. AT 250°F.)

Fig. 12.—Comparative chemical resistances of various resinous clear films

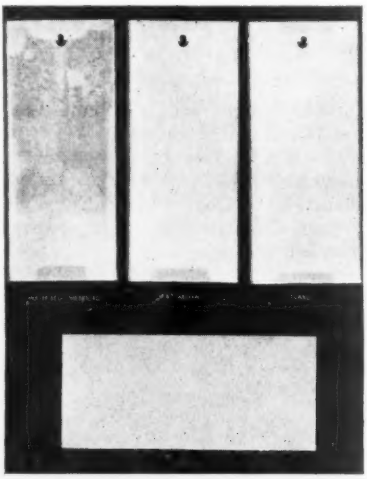


Fig. 13.—A 50-cycle weatherometer test of litho-red pigmented A-resin (top centre), *modified phenolic* (left) *and alkyd* (right) *panels, compared with a control panel* (bottom)

Future development work is now in progress to synthesize other resins for specific uses in cases where a general purpose resin had definite shortcomings.

But the indications are that only the threshold has been reached of the development of petroleum as a source of resin raw materials and of new resins of the hydrocarbon polymer type. Certainly there are enough interesting avenues still ahead to fire the imagination and curiosity and to stimulate further research efforts.

It only remains to say that plastics are but one more development in an industry which is, to-day, the parent source of countless products indispensable to the daily pattern of our lives. The scope afforded by the availability of good hydrocarbon monomers and the use of improved polymerization techniques is very great, while the potential commercial applications of hydrocarbon resins are no less impressive.

THE CADMAN LECTURER IN THE BRANCHES

DURING the visit to England of Mr Robert P. Russell the opportunity was taken for him to address the various provincial branches of the Institute.

IN SCOTLAND

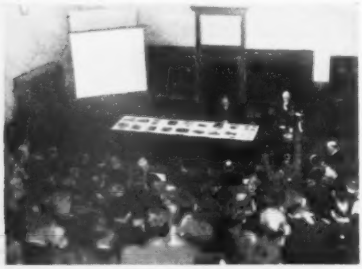
The first of such visits was to Edinburgh, where on June 2 the members of the Scottish Branch heard Mr Russell discourse on the subject of "New Developments in the Synthesis of Hydrocarbon Fuels", in the Heriot-Watt College.

Welcoming the lecturer, Mr Robert Crichton, the Chairman, referred to the service which he had rendered the Allied cause during the war. As Chairman of the Petroleum, Chemical and Rubber Division of the U.S. Strategical Bombing Survey, Mr Russell had headed a team of scientists who followed the Allied troops into Germany after D-Day to survey the enemy's vast oil-chemical industry.

He congratulated Mr Russell on being the Cadman Medallist for this year and recalled that the late Lord Cadman had been closely associated with the Scottish shale oil industry and, as a young man, had visited the mines and works regularly in his capacity as Inspector of Mines.

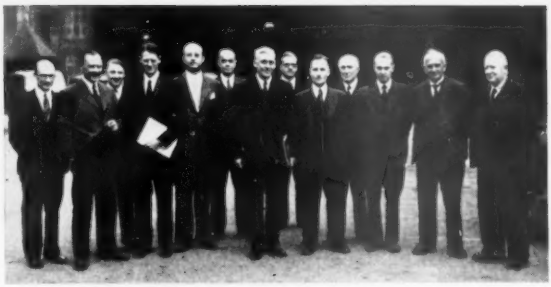
At the conclusion of the address the audience, which numbered over 200 and included many visitors from the Universities of Glasgow and Edinburgh, from the technical colleges and secondary schools, and from cognate societies, remained to inspect exhibits, to witness demonstrations, or to question Mr Russell and his assistants.

After the meeting had terminated, Mr Russell and his associates, Dr P. E. Hardy and Mr J. Hall, were entertained at an informal dinner by the Scottish Branch. The Chair was taken by Mr Robert Crichton and those present included:



(Above) *Robert Crichton introduces R. P. Russell to his Scottish audience seen below from the lecturer's view-point. W. Robert Guy, secretary of the Branch, is on the left of the front row with Dr G. H. Smith*

After the lecture, the Cadman Medallist was entertained to dinner by the Scottish Branch and, obviously, with true Scottish hospitality



A noteworthy gathering in Manchester. Left to right—*C. Chilvers, H. H. Ballard, R. T. Haslam, H. C. Tett, C. Gysin, E. J. Dunstan, R. P. Russell, A. W. Wooldridge, G. H. Thornley, Dr Withers, Prof E. L. Hirst, Prof J. Kenner, and Dr S. R. Best*

I. G. Brackenridge; J. A. Brown; J. Caldwell; Dr J. R. Campbell (*Royal Technical College, Glasgow*); Prof W. M. Cumming; A. Fleming (*Hon Recorder*); J. T. Guthrie; W. Robert Guy (*Hon Secretary*); Prof J. P. Kendall (*University of Edinburgh*); H. McArthur; J. McCracken; Prof G. F. Marrian (*Society of Chemical Industry*); Prof H. Nisbet (*Heriot-Watt College*); D. S. Paul; H. Peden; Dr E. G. V. Percival (*Royal Institute of Chemistry*); Principal J. Cameron Smail (*Heriot-Watt College*); Dr G. H. Smith; — Stalker (*"The Scotsman"*); H. C. Tett (*Chairman of Council*).

In the North-West

For Mr Russell's visit to the north-west of England on June 11, the Northern and Stanlow Branches arranged a joint meeting which, through the courtesy of the authorities, was held in the Chemistry Lecture Theatre of the Manchester University. The Chair was taken by G. H. Thornley, Chairman of the Northern Branch, and the audience of about 250 included members of the University and of the local sections of various cognate societies.

At the conclusion of the meeting the vote of thanks was proposed by Prof E. H. Hirst, director of the Manchester University Chemical Laboratory and seconded by C. Gysin, Chairman of the Manchester Section of the Society of Chemical Industry. It was carried by acclamation.

An informal dinner to Mr Russell and his colleagues was held in the Midland Hotel and, as the local report puts it, the products of benevolent reaction followed the concentration of the lecture. Guests at this happy function included:

Dr S. R. Best (*Royal Institute of Chemistry*); C. Chilvers (*Institute of Petroleum*); C. Gysin (*Society of Chemical Industry*); Prof E. L. Hirst (*Manchester University*); Prof J. Kenner (*Manchester College of Technology*); T. Penny (*Institution of Chemical Engineers*); H. C. Tett (*Institute of Petroleum*); Dr Withers (*Chemical Society*); the following members of the Stanlow Branch Committee, C. D. Brewer, J. L. Black, J. G. Hancock, E. Stokoe, and members of the Northern Branch Committee, G. H. Thornley (*Chairman*); H. H. Ballard, E. J. Dunstan, V. M. Farrant, R. T. Haslam, A. W. Wooldridge.

At the Midland Hotel, Manchester, (above, left to right) *H. C. Tett, R. P. Russell, G. H. Thornley, T. Penny, Prof E. L. Hirst, Dr S. R. Best, C. D. Brewer and "Johnnie" Hall,* (below) *V. M. Farrant, E. Stokoe, Dr P. E. Hardy, E. J. Dunstan, J. L. Black, C. Chilvers, R. T. Haslam, and J. G. Hancock*

In South Wales

When, on June 12, Mr Russell addressed the members of the South Wales Branch in the Banqueting Hall of the Guildhall, Swansea, the Chair was taken by General Sir A. R. Godwin-Austin, K.C.S.I., C.B., O.B.E., M.C., chairman of the South-Western Division of the National Coal Board. The audience numbered about 250, including members of local scientific societies, of the university, and of interested local industries.

At the conclusion of the lecture a vote of thanks was proposed by Dr C. A. Edwards, Principal of the University College of Swansea, who remarked that he was very envious of all the facilities which appeared to be available and thought it would be a very fine idea if the various universities were in a position to produce such magnificent means of demonstrating their lectures.

Mr H. C. Tett, Chairman of Council of the Institute of Petroleum, seconded the proposition and in the course of his remarks stated that he was pleased to make this early contact with the South Wales Branch and as a result felt that he need have no qualms as to its activities.

Finally, Mr R. B. Southall, Chairman of the South Wales Branch, thanked General Sir A. R. Godwin-Austen on behalf of the Branch for taking the Chair at the meeting.

Subsequently Mr Russell and his colleagues were guests at an informal dinner in their honour, also in the Guildhall, given by Mr R. B. Southall, general manager of National Oil Refineries Ltd. In welcoming the principal guest, Mr Southall pointed out that, although he was in Wales, he would soon notice that there were mixed nationalities present. In addition to Welsh, Scottish and Irish, there were quite a number of "free" English.

The company present included General Sir Godwin-Austen and members of the National Coal Board, the chairmen or secretaries of local branches of various scientific societies, members of trade associations, and senior members of the staff of National Oil Refineries Ltd.

In Birmingham

Mr R. P. Russell gave his lecture at Birmingham on "Plastics and Resins from Petroleum", on June 10 in the English Lecture Theatre of the University of Birmingham at Edmund Street, the Chair being taken by Professor F. H. Garner, O.B.E., Dean of the Faculty of Science. There was an audience of over 250 people, including some members of the Institute's Birmingham Student Section. The lecture, which was illustrated by experiments, was delivered with the skill of a master, and Mr Russell gave adequate replies to a number of questions at the end of the lecture.

Earlier in the day Mr Russell had lunch at the University of Birmingham, Edgbaston, with the Pro-Chancellor, Mr Sidney Vernon, Professor M. Oliphant, Professor Sir Norman Haworth, Professor F. H. Garner, the Registrar (Mr Grant), the Chairman of Council of the Institute of Petroleum (Mr H. C. Tett), the Honorary Secretary of the Institute (Mr C. Chilvers), and Mr J. L. N. Pollock.

Professor Haworth showed Mr Russell the first sample of synthetic rubber (made in the nineties by Sir William Tilden in the University of Birmingham), which is to be exhibited in the Centenary Exhibition of the Chemical Society; much to his regret, Mr Russell forgot to mention this in his evening lecture when he made some synthetic butyl rubber.

The Lighter Side of the Tour

The travels of the Russell entourage in Britain were not without their lighter side, as all who met "Johnnie" Hall (photographer, projectionist and general factotum) and Dr P. E. Hardy (demonstrator) can well imagine. The following

incidents, in particular, have been brought to our notice.

When the party left Edinburgh on the night train for London, they were accompanied to Waverley Station by members of the Branch Committee. Before the train departed the Committee had, by stratagem, achieved possession of the most resplendent necktie seen in Edinburgh for many a year. Johnnie Hall had been responsible for some wonderful colour effects on the screen but these were far outdone by those which he contrived to display at the projector end of the operation. The necktie now forms an interesting addition to the Branch regalia and it is hoped that the explanation will be accepted by Mrs Hall when the original owner returns to New York.

While in Swansea the car in which our two friends were travelling became involved in an unavoidable but minor collision. Immediately, out jumped the two demonstrators to take cine-photographs of the episode, at the same time, by signs and general remarks, requesting the occupant of the other car, who was looking most annoyed, to "Hold it, buddy, and look wild". This so amused him that he decided to let the matter drop.

Later, when being shown the Brangwyn Hall with its famous panels, the reaction was equally rapid. Out came the cameras and shots were taken from all angles before anyone could prevent it. The Hall Superintendent did his best, but gave it up and retired hurriedly, remarking to their guide: "For God's sake, sir, please see that they don't put their initials on the panels."

The two were shown round the Swansea Council Chamber, probably one of the most beautiful and awe-inspiring in Wales. But this did not deter them from occupying the mayoral chair and taking cine-photographs of each other with appropriate actions. It is unlikely that such scenes will ever again be shot in such surroundings.

We were intrigued with the many gadgets which Messrs Hall and Hardy used to facilitate their screen work and demonstrations, all of which helped to establish a new high standard for technical lecturing. But there was at least one British gadget which was new to our overseas visitors and which will be taken back to America as a find. We refer to the mirror in the lecture theatre of The Royal Institution which enables the speaker to see what is on the screen behind him.

A NEW JOURNAL

Of interest to the petroleum industry is the *Journal of the Institute of the Motor Industry*, the first number of which is dated May, 1947. The chief articles are "The Aircraft Gas Turbine" by Air Commodore F. Whittle, and "The Institute and the Future of the British Car Industry" by the president, the Rt. Hon. Lord Sempill. A short section on Abstracts from the Technical Press.

For the time being publication will be three times per year, and it is hoped in due course not only to publish papers read before the Institute but also to publish original contributions specially written for the *Journal*.

THE HERBERT AKROYD STUART AWARD

The Institute of Marine Engineers announces that the above award, value £50, is open to members or non-members of the Institute for the best paper on the origin and development of heavy oil engines submitted during the two years ending April 30, 1949. The paper, which should not exceed 10,000 words and 24 illustrations, must be the sole work of the competitor and any outside source of information must be acknowledged. To avoid repetition of early history, intending competitors are advised to examine previous prize-winning papers in the *Transactions* of the Institute.

THE OUTSIDE CHANCE

THOSE engaged in the oil industry, more especially those who sojourn abroad, recognize that, despite its world-wide ramifications, the oil family is comparatively small. When one runs into Livingstone, last heard of in Egypt, in the backwoods of South America, one does not remark "Dr Livingstone, I presume?" There is nothing extraordinary about the meeting. The modern version of the phrase is without doubt "What's yours?" There are, however, extraordinary coincidences on occasions and for the benefit of any budding historian the following outside chance is recorded.

In the year 1929, two of the younger members of the Institute wrote and presented a paper on "Trinidad Well Waters". Their location was and had been for some years, Trinidad. The Chairman of the meeting, Mr Alex Duckham, in opening the discussion, said: "——the chief of the wider aspects of the paper was the striking example it afforded of the value of whole-hearted co-operation between companies and companies, and between companies and a Government department. It appealed to him that one of the authors was a Government official and the other the employee of a company." To this might be added the further fact that one was a geologist and the other a chemist.

Shortly after, because of the oilman's wandering propensities and not as an outcome of the wider aspects, both members left Trinidad for good and their separate ways were widely divergent. Meetings were infrequent and finally, with one located in England and the other in Australia, they petered out. World War II broke out and down came the iron curtain.

During the early years of the War the Anglo-Iranian Oil Company developed in England commercial production of the order of 2,000 tons a month and this indigenous crude oil was shipped by rail to their refinery at Grangemouth, Scotland, for cracking to motor spirit and DERV. At the end of 1941 this commercial production had been built up to around 4,000 tons a month. For economic and transport reasons arrangements were made at this stage to ship the indigenous crude to the Lobitos refinery at Ellesmere Port, Cheshire, for the production of lubricating oils and wax. The arrangement was that the Petroleum Board purchased the indigenous crude from the Anglo-Iranian Oil Company at the field rail sidings and shipped it by rail to the refinery where it would be refined by Lobitos on behalf of the Petroleum Board. The chemist was manager of the Lobitos refinery.

The refinery was oriented for crude oil receipts by tanker. Indigenous crude oil was scheduled for receipt by rail. Petroleum Board transport officials arrived to discuss the problem. The chemist stated that it would simplify matters if he had direct contact with the responsible official on the field. The transport official gave a name which corresponded with that of the geologist. It WAS the geologist.

CANADIAN DEPLETION ALLOWANCES

NEW regulations (P.C.1046 of March 25, 1947), under the Canadian War Tax Act for depletion allowances include the following in regard to oil and gas wells:

The depletion allowance in respect of oil wells located west of the Province of Ontario shall be $33\frac{1}{3}$ per cent of the net profits from the production and sale of oil.

The depletion allowance in respect of oil and gas wells located east of the Province of Manitoba and of gas wells located west of the Province of Ontario shall be 25 per cent of the net profits from the production and sale of oil and gas.

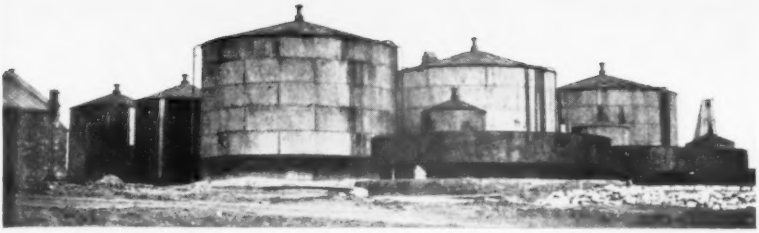
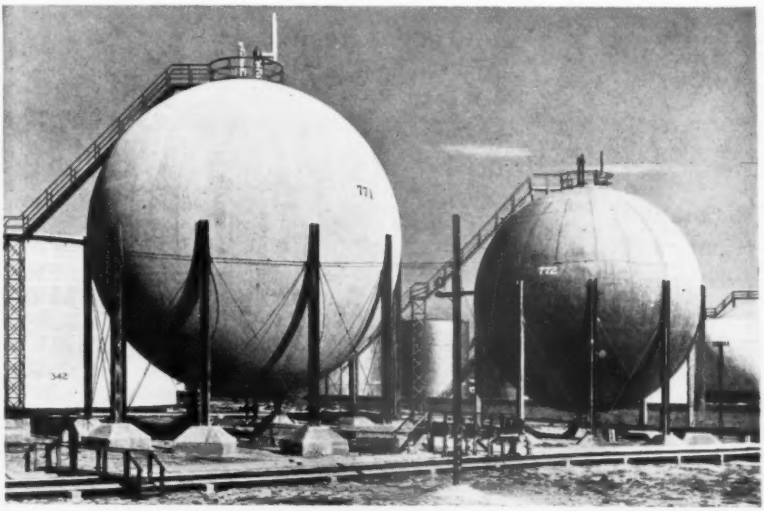
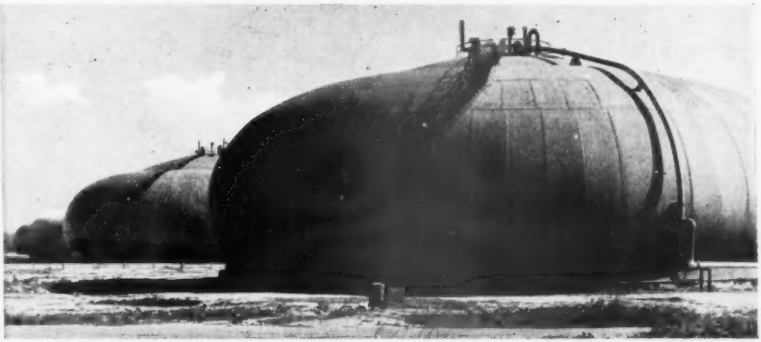


Photo by Arthur W. Eastlake

THEN AND NOW

The tank farm shown above was photographed in Binagadi in 1914, and those below are part of the modern tank farm of the Aruba refinery of the Lago Oil and Transport Co., Ltd. The sphere and spheroid tank is used for storage of butane and other gases under pressure





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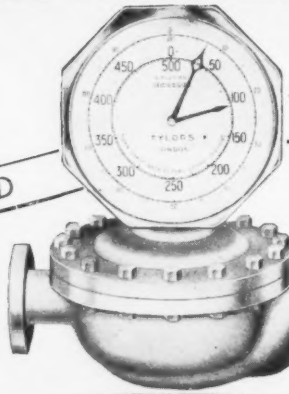

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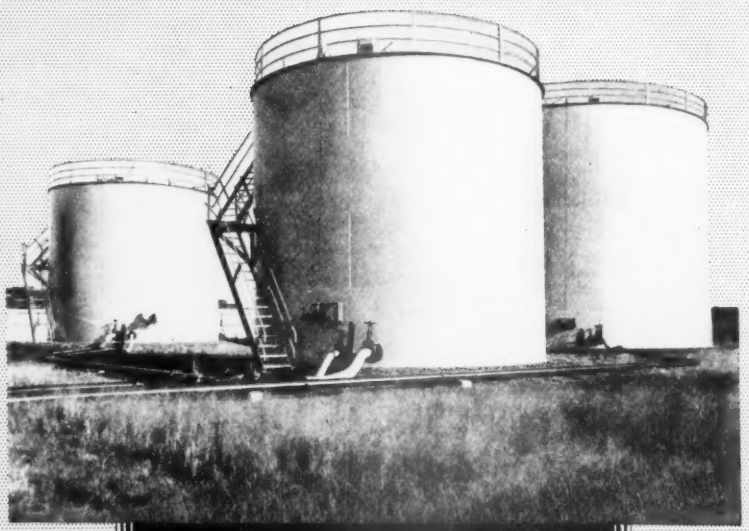

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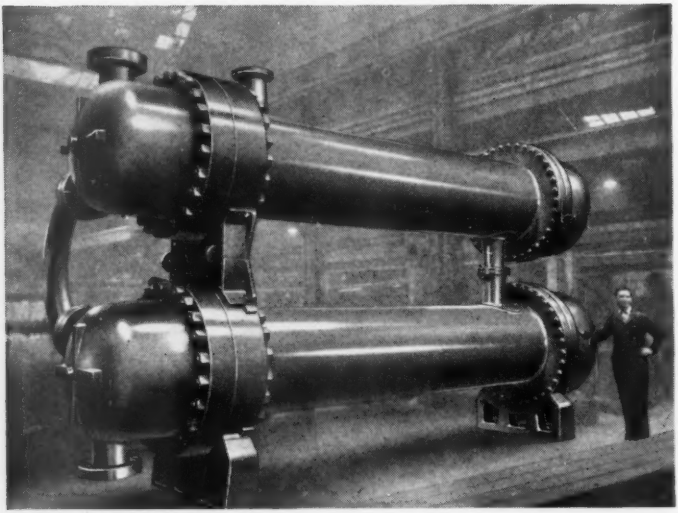

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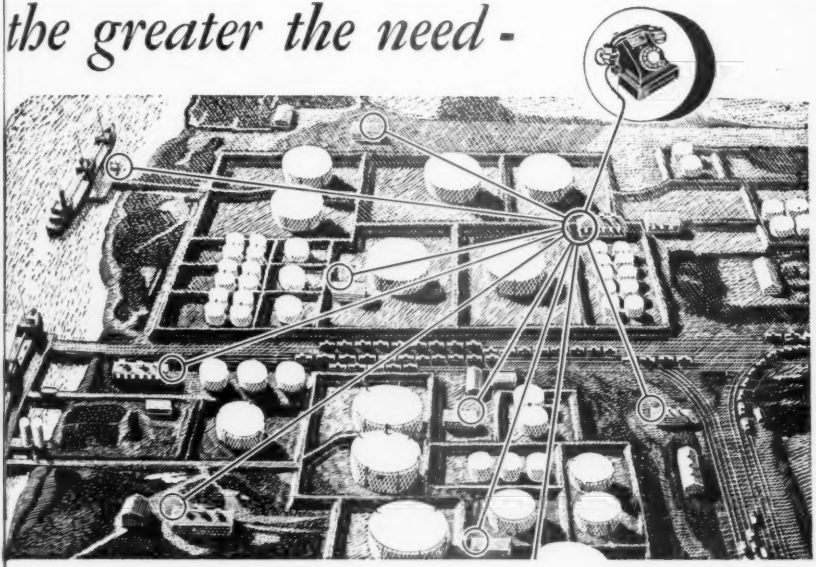

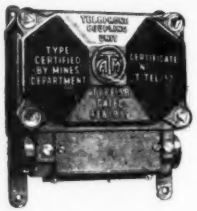

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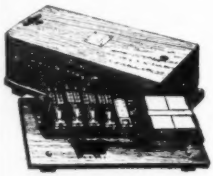

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